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MANAGEMENT OVERVIEW OF SYSTEM TECHNICAL SUPPORT PLAN FOR THE FI--ETC(U)
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6 AUGUST 1980

DRCPM-FFR-TM-0880

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MANAGEMENT OVERVIEW OF SYSTEM TECHNICAL SUPPORT PLAN FOR THE FIREFINDER SYSTEM SUPPORT CENTER

6 AUGUST 1980

PREPARED BY:

LESLIE R. HESELTON, III
SEMCOR, INC.
STRAWBRIDGE LAKE OFFICE BUILDING
MOORESTOWN, NEW JERSEY 08057

PREPARED FOR:

OFFICE OF THE PROJECT MANAGER
FIREFINDER/REMBASS
DRCPM-FFR-TM
FORT MONMOUTH, NEW JERSEY 07703

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This plan establishes the policies, plans, and procedures that will form the basis for providing post deployment system support to the FIREFINDER systems. The plan is based on the best available information concerning both the systems and the required level of system support. Due to the lack of historical Army precedence and this being one of the first such plans, the validity of the information and the assumptions made are subject to interpretation and future validation.

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FOREWORD

This final technical report was prepared by Leslie R. Heselton III of SEMCOR, Inc., Moorestown, NJ and covers work performed under Contract DAAK20-79-D-0500 during the period December 1978 through August 1980. The work was funded under Delivery Orders 3 and 5, Task 1 by the Office of the Project Manager FIREFINDER/REMBASS, Fort Monmouth, New Jersey 07703. The Army technical points of contact were Lawrence P. DeCosimo and Richard Bertolini.

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INTRODUCTION

1.1 BACKGROUND

The Radar Sets AN/TPQ-36 and AN/TPQ-37 represent the state of the art in counter-mortar and counter-artillery radars. Both systems are computer controlled and depend on software for controlling hardware and processing target information. This dependency on software for operating the radar could lead to a major maintenance support problem. Appendix E contains a description of the FIREFINDER SYSTEMS.

The high degree of interaction between the software and hardware makes it difficult to determine whether or not the cause of a fault is software or hardware. A field repairman could exhaust all of his hardware troubleshooting techniques and still not determine the problem if the fault was in the software. Field maintenance personnel must have a new method for dealing with software problems to adequately support FIREFINDER systems.

1.2 PURPOSE

This System Technical Support Plan (STSP) outlines the way to correct software problems. The most obvious technique is to thoroughly train the field repairman in system software. However, the anticipated number of software problems does not support the cost and manpower required for this technique. Instead of training the field repairman to fix software faults, the Office of the Project Manager (OPM), FIREFINDER/REMBASS, plans to establish a System Support Center (SSC) to resolve software faults or problems.

Under this plan, the FIREFINDER System Support Center (FFSSC) is a part of the Electronic Research and Development Command's (ERADCOM) Software Support Center. The personnel at the FFSSC are trained in both the system software and hardware. The FFSSC's responsibilities are (1) to assist field personnel in determining if a problem is caused by a hardware or software fault, and (2) to correct any software faults. This can be done, depending on circumstances, through telephone calls or onsite visits. The FFSSC also assists the system manager in solving hardware faults.

This STSP describes how the FFSSC operates and works with the field, and shows the interfaces between the center and other agencies that support the FIREFINDER systems.

SECTION 2

MAINTENANCE REQUIREMENTS

2.1 SYSTEM DESIGN

The FIREFINDER systems' design emphasizes reliability and maintainability to meet a 96-percent operational availability requirement. The maintainability goals are accomplished by built-in test (BIT) for on-line and off-line testing throughout the radars.

Before a mission, the operator initiates the on-line BIT, which causes the system to test itself and determine its current status. When the mission starts and there is dead time in the system, the computer initiates self-test routines. Thus, the system continually checks the status of its subsystems. If a fault is detected, an audio/visual alarm notifies the operator. If the fault does not interfere with the mission, the operator may continue. If he wants to repair the fault, he terminates the mission and runs the fault isolation programs.

The off-line diagnostic computer programs are designed to fault isolate the detected fault to the lowest repairable module, card, or group of cards. Organizational maintenance personnel can isolate and fix 90 percent of all unscheduled maintenance equipment failures in an average of 30 minutes, using the diagnostic software, the Technical Manual (TM), and on-board spares, which are part of the Prescribed Load List (PLL).

2.2 MAINTENANCE CONCEPT

The AN/TPQ-36 and AN/TPQ-37 maintenance goal is to have the lowest maintenance echelon perform the maximum number of repairs. This goal is accomplished by computerized BIT, good modular design, and easily replaceable circuit cards. The BIT enables the Organizational Repairman to quickly locate faulty circuit cards. The modular design allows him to replace them quickly and easily. If the Organizational Repairman cannot find or repair the fault, he calls the Direct Support Repairman.

The Maintenance Support Teams (MST's) provide Direct Support maintenance to systems in the field. When needed, the MST travels to the radar site to repair the equipment. He carries any additional test equipment and spares that may be needed to fix the system. The Organizational and Direct Support maintenance personnel can correct over 90 percent of all possible equipment failures in the field.

The General Support (GS) level of maintenance for the FIREFINDER systems will be the repair of faulty circuit cards and their return to stock. When the MST cannot correct the faults, the system or its components are evacuated to the depot for repair. The Sacramento Army Depot is the main depot for both systems.

2.3 SOFTWARE FAILURES

The systems' dependence on software presents a new aspect in maintenance support. A software failure can shut the system down as effectively as a hardware failure, but there is no way for a field repairman to determine that a software failure has occurred. All he can do is try all of the prescribed troubleshooting procedures and then declare he cannot repair the system failure. Under the current Army repair concept, the system is then evacuated to a depot.

Training the field repairman to correct software problems could prevent evacuating a faulty system, but it is not cost effective for the FIREFINDER systems. The anticipated stability of the software, along with the cost of training personnel in the software and the problems associated with maintaining configuration control of the computer programs, do not justify expanding the MST's (DSU) duties to repairing software faults. As an alternate solution, the OPM, FFR plans to establish a System Support Center.

2.4 FIREFINDER SYSTEM SUPPORT CENTER CONCEPT

The FFSSC serves as the systems engineer for both radars, providing expertise for discriminating between software and hardware faults, correcting software problems, and maintaining the system software library. The FFSSC is not involved with the daily support of the systems. It becomes involved only when the MST is unable to correct the problem after trying all his troubleshooting techniques. The MST contacts the FFSSC, if possible by telephone, and seeks additional help.

The FFSSC determines if a hardware or software fault is causing the problem, based on the information provided. Depending on the system's operational status, the FFSSC may send someone onsite to correct the problem or obtain additional information. If the problem is caused by a software fault, the FFSSC develops a fix and prepares a new version of the computer program containing the fix. If the problem is hardware related, the FFSSC notifies the system manager (OPM, FFR or CERCOM) and works with him to resolve it. Figure 2-1 illustrates this system support concept.

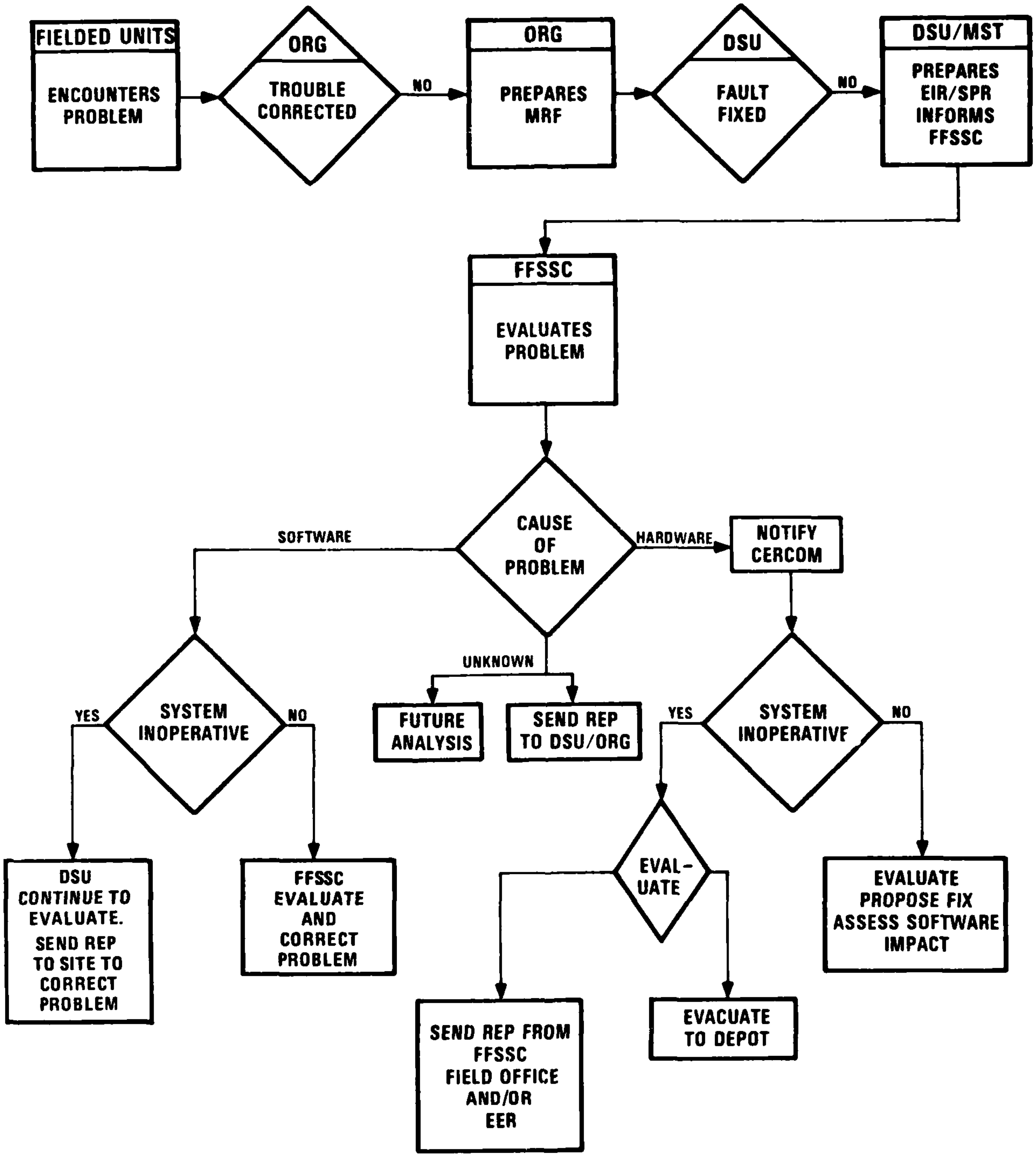
2.5 IMPACTS

The FFSSC does not replace any existing support activity. It serves as the radars' systems engineer, develops and maintains a high level of expertise, analyzes problems, and develops solutions.

The FFSSC can significantly improve the Army's capability to support the FIREFINDER systems. It (1) eliminates the need to evacuate non-failed equipment to a depot and (2) determines, at a minimal cost and within an acceptable amount of time, whether a hardware or software fault is causing the problem. The FFSSC can also evaluate any hardware changes that may adversely affect the software and cause the system to not operate.

The form currently used by troops in the field to request assistance for maintenance support and to document equipment faults, Maintenance Request Form (MRF) DA Form 2407, was designed for hardware problems. For systems which incorporate computer software a new form, System Problem Report (SPR), contained in Appendix G, is required to report system problems. The SPR is attached to the Equipment Improvement Recommendation (EIR), Quality Deficiency Report (SF 368), and completed along with the MRF whenever the fielded units request assistance from the FFSSC. The following information is required on the SPR:

- Function(s) being performed
- Date and time when the trouble occurred
- Serial and number of tape cassette used
- Elapsed time from program start until trouble occurred, in hours and quarter-hours
- Length of time of operational interruption
- Description of the extent of system degradation due to trouble (for example, did the interrupt cause targets to be lost, affect operational capability, or have no effect on the mission?)



Note: During the Contractor Field Support Phase, the contractor will provide the FFSSC support.

Figure 2-1. General Maintenance Flow

- Description of corrective action
- Efforts to duplicate trouble to determine if it is reproducible
- Unit where trouble occurred
- Identification, by cassette number, of any simulation programs
- Indicate any link with other units (such as TACFIRE)
- Detailed description of events leading up to and coincident with the problem
- Computer stop data
- Possible cause of trouble (operator, set-up, hardware)
- Additional information pertinent to the trouble

SECTION 3

ORGANIZATIONAL CONSIDERATIONS

3.1 FIELD

Two factors must be considered if the FFSSC is to work successfully: (1) the FIREFINDER systems depend heavily on software to operate and (2) the FFSSC cannot solve all field problems; it is only to be used after all troubleshooting methods have been tried.

The repairman in the field must be aware that the system depends on the computer programs to operate. A software fault stops system operation as quickly as a hardware fault and is more difficult to find and correct. The DS maintenance course will cover the system software, not to teach field personnel how to correct software faults, but to show the interdependence of hardware and software and to explain how software faults can affect system operation.

The FFSSC should not be used for general-purpose troubleshooting. It should only be contacted after the MST has exhausted all prescribed troubleshooting routines. The FFSSC is cost effective because it responds only to major problems. Its value would diminish if the field called upon it to work on the minor problems that should be repaired by the MST.

3.2 FFSSC INTERFACES

The FFSSC must (1) fit into the current Army support system, (2) ensure that technical expertise is available when needed, and (3) correct software faults. The FFSSC interfaces with activities, such as, CERCOM, USAFAS, Field Artillery Interface Configuration Control Board (FAICCB), and the Marine Corps.

CERCOM will provide logistic support once the system is fielded. Since CERCOM normally interfaces with the field troops, the FFSSC must work very closely with them. If a software problem is found, the FFSSC determines the cause, fixes it, and ensures that an updated computer program is available to the field. It also assists CERCOM in resolving hardware-related problems by suggesting possible causes and solutions. CERCOM is responsible for repairing the fielded system.

The FFSSC must coordinate any recommended changes with the system users. The USAFAS is required to comment on the effect of any major changes regarding doctrine. The FAICCB ensures that proposed changes consider interface needs with other systems. The Marine Corps reviews all changes to ensure that they do not adversely affect its deployment of the AN/TPQ-36 system. Also, since it is possible to cause software faults by changing certain hardware components, the FFSSC reviews all hardware changes. Figure 3-1 shows the FFSSC interaction with these other activities.

3.3 SPECIFIC RESPONSIBILITIES

3.3.1 Office of Project Manager, FIREFINDER/REMBASS

The Office of Project Manager, FIREFINDER/REMBASS, is responsible for:

a. Ensuring system configuration management control and configuration status accounting for the FIREFINDER specifications and chairing the FIREFINDER Configuration Control Board (before transition)

b. Managing the systems' total life cycle

c. Supporting system engineering management

d. Providing overall coordination and technical management in solving problems that are not specifically hardware and software

e. Reviewing and monitoring reported problems and coordinating them, as required, to establish priorities; controlling emergency procedures; and ensuring necessary coordination and commitment of resources

f. Coordinating technical manual changes

g. Coordinating the development of new requirements and the implementation of doctrinal changes with TRADOC and the U.S. Army Field Artillery School

h. Providing the coordination required to ensure the capabilities of maintenance and diagnostic software

i. Coordinating the FIREFINDER interface with the FAICCB and interfacing systems

j. Providing guidelines and monitoring quality assurance and test and documentation functions

k. Conducting and/or witnessing acceptance testing of new software versions and accepting new versions

l. Coordinating any hardware modifications/field changes and their effect on software

m. Providing the coordination required to control logistics support

n. Providing required support to the FFSSC before transition

o. Providing funding for new requirements

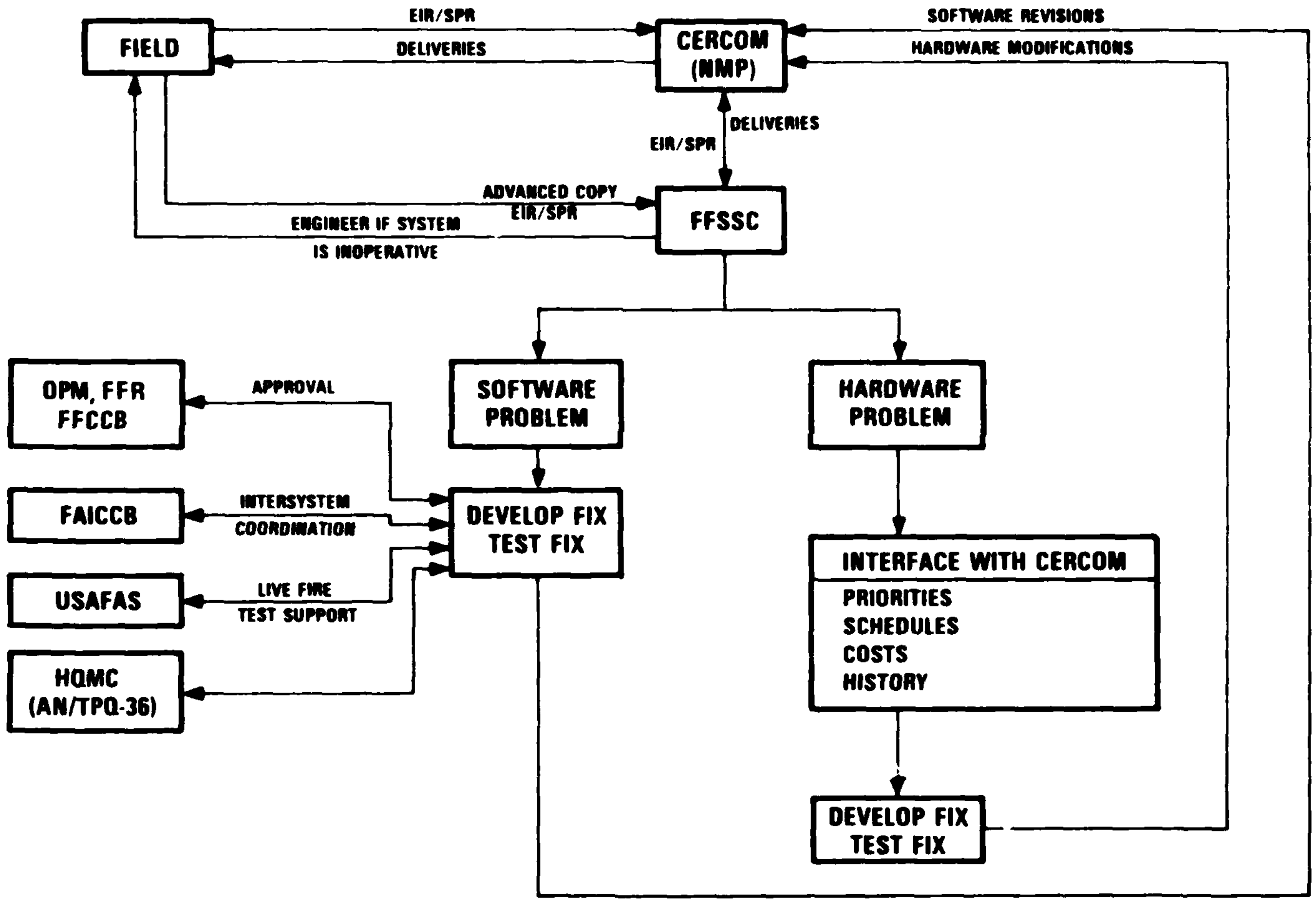


Figure 3-1. FIREFINDER Maintenance Organization Relationships

3.3.2 U.S. Army Field Artillery School

The U.S. Army Field Artillery School, Fort Sill, OK, as user representative for FIREFINDER, is responsible for the following:

a. Providing doctrinal guidance to OPM, FIREFINDER/REMBASS (before transition), CERCOM (after transition), and the FFSSC

b. Establishing requirements and justifying system enhancements

c. Participating in acceptance testing (see Section 4.3)

d. Providing user interpretation of equipment improvement reports as required

e. Preparing training packages to be fielded with new computer program releases and modifying continuing training programs

f. Training the electronic equipment representative, the MST, and the user/operator

g. Serving as a member of the FIREFINDER Configuration Control Board

3.3.3 CERCOM

The Maintenance Directorate, U.S. Army Communications and Electronics Materiel Readiness Command, Fort Monmouth, NJ, serving as the National Maintenance Point, is responsible for:

a. Publishing, maintaining, and distributing the required technical manuals

b. Preparing and providing the required worldwide technical assistance for logistics and maintenance in accordance with applicable regulations

c. Serving as the focal point for receiving problem reports, EIR's, and so forth, from the field; routing to the appropriate agency; and distributing MWO's, new version tapes, and associated documentation to the field

d. Providing overall system configuration management and control for the FIREFINDER systems after transition

e. Collecting data in accordance with TM 38-750

f. Reviewing all software EIR's for any effects on hardware

g. Serving as a member of the FIREFINDER Configuration Control Board before transition and as chairman after transition

h. Providing required support to the FFSSC after transition

3.3.4 FIREFINDER System Support Center

The FFSSC is responsible for the following:

a. Specifying and implementing configuration management control and configuration status accounting of the fielded FIREFINDER software (object code) and firmware and its documentation (source listings, flow charts, technical descriptions, operator's manuals, and software manuals)

b. Reviewing, evaluating, analyzing, and resolving all problem reports

c. Maintaining the accuracy of the software documents and supplying the NMP with the data needed for updating appropriate publications

d. Providing configuration control and status accounting of the FIREFINDER software compiler/assembler

e. Managing the contractor effort to ensure the required system support

f. Programming (coding) the FIREFINDER software

g. Maintaining required applications software, support software, and diagnostic software

h. Controlling and updating the certification and verification of test procedures and scenarios

i. Coordinating acceptance testing with the Field Artillery School

j. Managing the production of changed/modified tape versions to the baseline

k. Providing engineering assistance to the field as required

l. Conducting certification and verification testing

m. Participating as a member on the FIREFINDER Configuration Control Board

n. Providing technical support to OPM, FIREFINDER/REMBASS concerning FAICCB actions before transition and to CERCOM after transition

3.3.5 Digital Map Production Facility

The responsibilities of the Digital Map Production Facility (HQDA has not designated a location for this facility which is anticipated to be an active Army unit) include:

a. Providing configuration control and status accounting of FIREFINDER digital maps

b. Coordinating with the FFSSC during updates or modifications to the digital maps

c. Delivering updated/current cassette digital maps

3.3.6 Headquarters, U.S. Marine Corps (HQMC)

The Commandant of the U.S. Marine Corps, Washington, D.C., is responsible for these tasks concerning the AN/TPQ-36:

a. Providing funding to the U.S. Army to train USMC operators, maintenance technicians, and other personnel

b. Providing user interpretation of USMC equipment improvement reports, as required

c. Witnessing acceptance testing

d. Establishing requirements and justifying system enhancements

e. Serving as a member of the FIREFINDER Configuration Control Board

3.3.7 FIREFINDER Configuration Control Board

The FFCCB serves as the primary body for categorizing all system modifications, assessing change, ensuring that approved changes are implemented, determining the level of the testing/validation effort, and controlling the release of new software versions. The FFCCB is responsible for controlling all system changes and software/hardware interface throughout the configuration item life cycle. The following organizations provide members to the FFCCB:

a. OPM, FIREFINDER/REMBASS - chairman before transition

b. CERCOM - chairman after transition

c. USAFAS

d. FFSSC

e. HQMC

SECTION 4

SYSTEM SUPPORT CENTER

4.1 SYSTEM PROBLEM REPORT PROCESSING

The complexity of the hardware and software integration in the FIREFINDER systems requires that a knowledgeable and competent systems engineer thoroughly troubleshoot the failures. He needs expertise in radar theory, circuit design, fault analysis, systems engineering, and programming technique to evaluate, modify, and make changes. It is not cost effective to train field personnel to become proficient in solving all system faults, especially software problems. The FFSSC will have the FIREFINDER software and hardware expertise.

The processing of a System Problem Report (SPR) in the FFSSC is shown in Figure 4-1. The FFSSC receives the SPR along with the EIR (see Section 2.5), checks it for duplication, records it, places it under configuration control, and analyzes it to determine whether it is a hardware or a software problem. If the problem is software and the system is inoperative, an engineer may be sent to the originating unit to correct the problem onsite. This engineer develops and documents a repair in the field. When he returns to the FFSSC, the repair and documentation are placed under configuration management and delivered with the next computer program update. If the problem is software and the system is not inoperative, a software engineer analyzes and resolves the problem. Once a solution to the problem has been determined, the solution is documented, tested, entered in the library, and placed under configuration management for delivery with the next computer program update. If the FFSSC determines that the problem is hardware and CERCOM determines that the problem justifies a solution, a radar systems engineer assists in correcting the problem. If the system is inoperative, CERCOM may require an FFSSC engineer to repair it onsite. The priorities, schedules, costs, and history of the problem will be determined.

A problem analysis includes factors such as system impact, memory requirement, design tradeoffs (hardware or software), test requirements, BIT/diagnostic changes, and training modifications. The engineer develops and tests the repair and delivers it to CERCOM for the fielded units. The

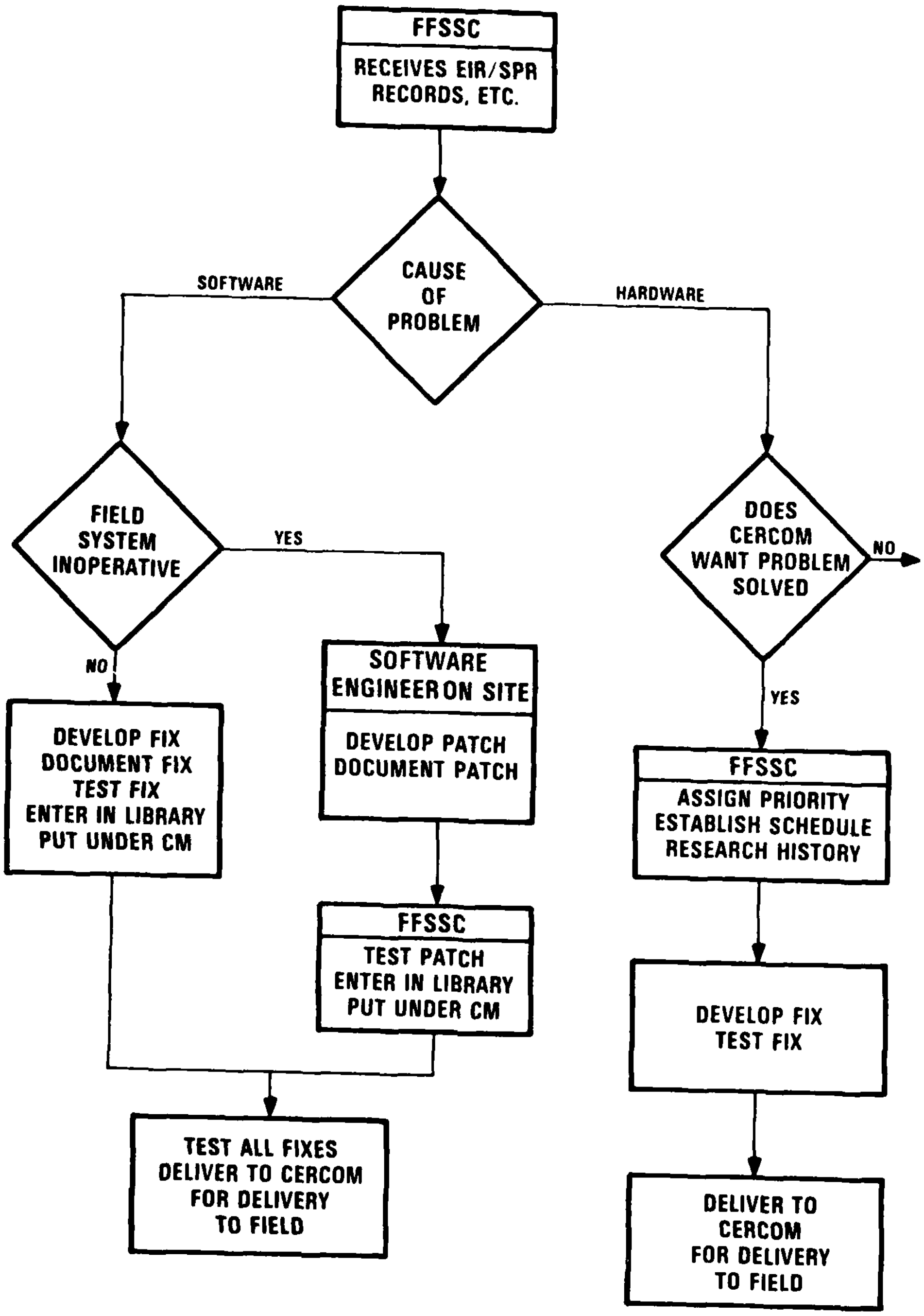


Figure 4-1. FFSSC System Problem Report Processing

FFSSC configuration management group ensures that all changes/updates/ modifications to the hardware and software are approved by the FFCCB.

4.2 SOFTWARE TESTING

The extent of the software change determines what type and how much software testing is required, including subprogram/module, function, and/ or system performance tests. Simulation may also be used as needed. The FFSSC determines the specific areas (functions/modules/modes) in which testing will be done, and where applicable, the parameters (values) to be used during testing. It develops the test procedures needed to validate the change. The subprogram/module tests consist of the following:

a. Error-free compile/assembly of the changed subprogram/module

b. Verification of the coded subprogram/module to ensure that it actually reflects the requirements

c. Subprogram/module exercise in terms of input performance

When function tests are performed, all subprogram/module testing will have been completed. The subprograms/modules are integrated individually into the subsystem programs until it has been verified that the subprogram actually reflects the requirements. System performance tests are conducted after all subsystem programs have completed functional testing; all subsystem programs are integrated into the system program. System tests, as a minimum, consist of:

a. Verifying the man-machine interface

b. Validating system initiation, data entry, program loading, and monitoring and controlling system operations

c. Verifying system integration of equipment and subsystems

After the appropriate testing is successfully completed, the coded change is certified, and the software library is updated.

After the change is verified and validated at the FFSSC, the applicable documentation is updated. When the extent of the change or circumstance requires it, live-fire acceptance testing is performed by the U.S. Army Field Artillery School, Fort Sill, OK. After successful testing, CERCOM ensures that the system tapes are distributed to the various user activities.

4.3 SYSTEM TESTING

There are three types of testing involved in system testing:

a. Certification — Certification comprises those design tests conducted by FFSSC personnel to ensure that individual system modifications as well as the integrated operational system will perform correctly and according to the associated design documentation and user guides.

b. Verification and Validation — Verification determines that the system is developed in accordance with all invoked and imposed operational and technical standards and specifications. Verification is accomplished by reviewing and comparing the specifications with equipment and computer lists. Validation of computer programs determines that the product satisfactorily performs the function for which it was designed and that all modifications actually correct the trouble. Validation will be conducted at the FFSSC and will be observed and controlled by OPM, FIREFINDER/REMBASS, or his authorized representative.

c. Acceptance — Acceptance testing is conducted in an environment consisting of as much actual operational and interfacing equipment as possible with the minimum amount of simulation; that is, live fire should be used. Acceptance testing should include the following categories: endurance, saturation, accuracy, limits and constraint, function, and degradation.

In the conduct of all the abovementioned testing, the need for data extraction and reduction is obvious. In order to significantly reduce the test time, both processes must be automated. The areas of data extraction and reduction must be continually reviewed for proper definition of the system parameters and formats required to support the test effort.

4.4 FFSSC FUNCTIONS

The primary objectives of the FFSSC are to evaluate and resolve user-detected system problems and to deliver to the users (via CERCOM) the latest computer program and system configurations with appropriate documentation.

To support the system maintenance objectives, the FFSSC must be capable of performing these functions:

a. Evaluating user-detected system problems, such as, computer program errors, supporting documentation errors, and wiring errors

b. Resolving user-detected problems by preparing appropriate program patches and/or documentation changes

c. Integrating and certifying systems, subsequent to the new deliveries, to meet new equipment capabilities or developments

d. Preparing program revisions resulting from the addition of patches and modules or from recompilation, and delivering the revised programs to the users by a suitable medium

e. Maintaining a system configuration control system and configuration record to ensure that all users are conforming with the required version

f. Maintaining all relevant documentation to ensure delivery of the revised documentation concurrently with the revisions/modifications

g. Developing and maintaining program maintenance test tools, such as, simulation programs and equipment, as required

h. Maintaining all program maintenance equipment in accordance with the specifications required for the user

i. Maintaining on-line test programs and diagnostics

4.5 EQUIPMENT REQUIREMENTS (See Appendix B)

The FFSSC needs the FIREFINDER common shelter and one each of the trailers to maintain the software life cycle. This equipment should be installed in the FFSSC as a complete shelter, allowing transportability to test sites. All the common shelter equipment used for software maintenance shall be identical in specification and performance to the equipment installed in the fielded systems.

Various other equipment is required for operational software maintenance, firmware development and updating, and simulator maintenance in addition to the common shelter equipment needed for FIREFINDER life-cycle maintenance. Some of this associated equipment will be dedicated to FIREFINDER, but the majority will be shared with other programs at the laboratory. A patch panel and the necessary cable runs are also required. The ERADCOM Software Support Center, along with FIREFINDER and other programs, will determine which laboratory equipment can be shared between programs. The associated equipment required consists of items such as firmware and software development panels, radar environmental simulators, graphic display terminals, printers, and disks. Appendix B lists all equipment required by the FFSSC.

4.6 PERSONNEL REQUIREMENTS

The EWL shall establish the FFSSC as a separate branch and provide personnel to the organization as required to support the system life-cycle maintenance. The following personnel will be assigned full-time to the FFSSC in consonance with the deployment of the FIREFINDER radar system and contractor support:

a. One systems engineer/supervisor
b. Three software engineers/computer specialists
c. Two radar system engineers
d. One radar/equipment technician

Appendix A describes these positions and those of the major support personnel. Figure 4-2 depicts the time-phased relationship of the dedicated personnel.

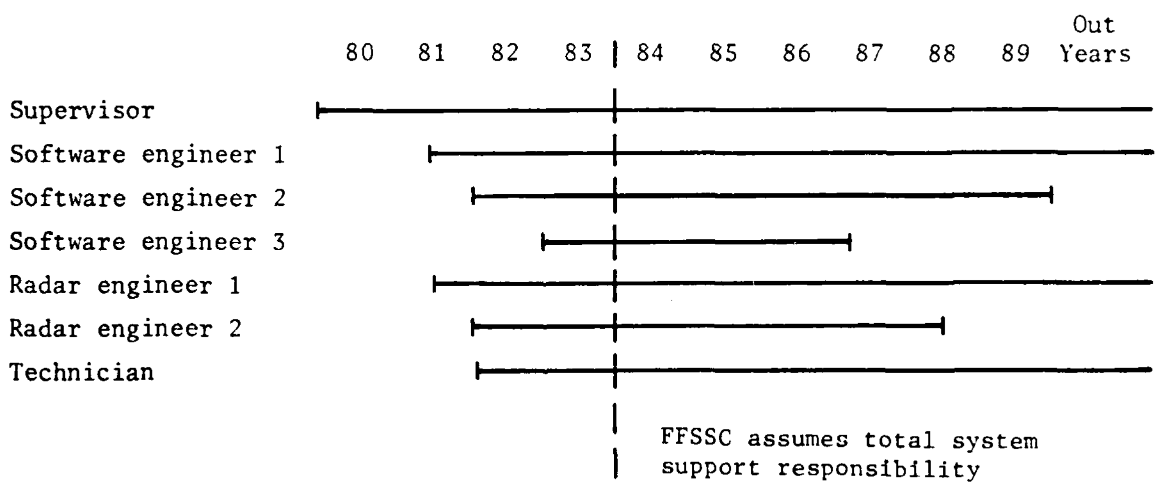


Figure 4-2. FIREFINDER Dedicated Personnel

4.7 FIELD SUPPORT

A Materiel Fielding Team will be initially assembled to aid in deployment and to carry out DARCOM commitments to the gaining commands. Contractor services (including field support) will be managed by OPM, FIREFINDER/REMBASS. Even though the contractor provides maintenance support during the first two years of the system's deployment, the Government still retains configuration control authority. The FFSSC approves the implementation of all SPR's and maintains configuration management over the entire system effort. Also, in conjunction with other agencies, the FFSSC tests (as deemed necessary) all system fixes before fielding. Once the necessary hardware is installed at the ERADCOM Software Support Center, FFSSC personnel will continually assume more responsibility for the life-cycle maintenance until the contractor is completely phased out.

4.7.1 Hardware Support

Where the depot is not ready to provide adequate support, the contractor provides it at his own facility. The depot maintains liaison with the contractor to ensure a smooth transition when complete depot support is established.

4.7.2 Software Support

Where the FFSSC is not prepared to provide systems and software support, the contractor provides it at his own facility until such time as the FFSSC is fully operational; thereafter, this support is provided at the FFSSC. The FFSSC monitors and provides all tasking to the contractor. Continuous liaison is maintained.

4.8 PROGRAM REVISIONS

To adequately plan the staffing and funding of the FFSSC, the anticipated workload for life-cycle support must be considered. For each revision, it will be necessary to analyze how the system presently works, optimal implementation of modifications, and how to design, code/build, and test the modifications. The complete system must be tested after implementation of the changes to ensure compatibility between modifications.

Periodic revisions to the computer programs will continue throughout the system life cycle from production and delivery to disposal. New deliveries are anticipated every six to nine months. Some justifications for these program revisions include:

a. Changes to correct programming errors

b. Changes in tactical operational philosophy and theater of operations

c. Target evaluation and selection

d. Introduction of new weapons systems

e. NATO and interservice requirements

f. Introduction or modifications of new hardware

g. Product improvements

h. Man-machine interface changes

SECTION 5
ACTIONS TO BE TAKEN BY AGENCIES

5.1 CERCOM

Fiscal year 1980:

- Formalize SPR form and procedures
- Develop MOU for interfacing with the FFSSC

5.2 TRADOC

Fiscal year 1980:

- Formalize training for maintenance and FFSSC personnel

5.3 OFFICE OF PROJECT MANAGER, FIREFINDER/REMBASS

Fiscal year 1980:

- Publish FIREFINDER System Technical Support Plan
- Initiate action to develop FFSSC
- Budget FIREFINDER system equipment for FFSSC
- Begin procuring FFSSC system equipment
- Prepare and establish System Support Agreements
- Contract with Hughes Aircraft for initial maintenance support
- Establish MOU for coordinating with USAFAS
- Establish FIREFINDER Configuration Control Board

5.4 ERADCOM SSC (FFSSC)

Fiscal year 1980:

- Continue FIREFINDER familiarization (BITE, training aids equipment)
- Prepare budget for required personnel
- Review and prepare budget for associated equipment requirements
- Initiate action to establish FFSSC
  - Obtain personnel
  - Prepare facilities and site readiness plan
- Prepare System Configuration Management Plan

Fiscal year 1981:

- Receive and install FIREFINDER system equipment
- Procure and install associated equipment
- Establish interface with HQMC
- Prepare Quality Assurance Plan
- Prepare input to the FIREFINDER Logistics Support Plan

APPENDIX A

POSITION DESCRIPTIONS FOR FFSSA PERSONNEL

This appendix briefly describes the positions required to accomplish FIREFINDER systems maintenance support at the Systems Support Center. The first four positions (total of six persons) are full-time FIREFINDER personnel (each of which may travel to the field sites to correct problems). The other personnel are provided on an as-required basis by the EWL.

A.1 FIREFINDER SUPERVISOR

The FIREFINDER supervisor shall be an experienced software systems maintenance specialist who is responsible for the overall direction of the division. The supervisor shall be the representative of Project Manager, FIREFINDER when interfacing with other Army agencies in the establishment of new computer programs and related equipment requirements for FIREFINDER. The supervisor shall also represent the maintenance activity on any configuration control boards that are relevant to the FIREFINDER Program. This supervisor should have a background not only in software systems maintenance, but in software configuration management, quality assurance, and the testing of software as well.

A.2 COMPUTER SPECIALIST/SOFTWARE ENGINEER

The FIREFINDER branch shall have three computer specialists/software engineers. One engineer shall be primarily responsible for the simulators and should have some radar experience. The second engineer shall be primarily responsible for the analysis and design of the BIT/BITE/ diagnostic programs. The third engineer shall be primarily responsible for the analysis and design of the operation/initiation and support programs. All computer specialists/software engineers are also responsible for the evaluation of trouble reports and change proposals in their assigned areas. Actual programming shall be accomplished by the three computer specialists/software engineers working as a team under the direction of the specialist for that particular area.

A.3 RADAR ENGINEER

The FIREFINDER branch shall have two radar engineers who are responsible for the evaluation of problem reports for hardware implications. These engineers should have a background in phased array and general radar particulars; experience in computer controlled phased-array radars would be useful.

A.4 TECHNICIAN

The FIREFINDER branch shall have at least one technician who monitors, controls, and operates the various equipment. The technician should also be able to assist in the hardware maintenance of the equipment as necessary.

A.5 SOFTWARE TEST ENGINEER

The software test engineer shall be provided by the EWL. The engineer shall be responsible for the preparation of test procedures and scenarios and for the actual conducting of testing. He will also assist in the analysis of trouble reports. The three computer specialists and the USAFAS will assist the software test engineer in conducting and preparing for testing.

A.6 HARDWARE MAINTENANCE

Hardware maintenance shall be provided by the EWL and shall include performing preventive maintenance, accomplishing hardware modifications and field changes, and performing all other equipment maintenance functions. Also, a hardware maintenance specialist will be provided for equipment support during system testing.

A.7 SOFTWARE LIBRARIAN

The software librarian shall be provided by the EWL and shall maintain the FIREFINDER computer program tapes, cards, listings, documents, and so forth, as required to support the configuration control of the system in the same manner as other EWL systems. The software librarian will also copy tapes and other documents, as necessary, to support the FIREFINDER maintenance effort.

A.8 OTHER SUPPORT PERSONNEL

The EWL will provide other support personnel to assist the FIREFINDER software division by supplying part-time support in the following areas:

a. General clerical and secretarial services

b. Documentation standards and production

c. Contract administration

d. Keypunching

e. Comptroller

f. General administration

g. Laboratory and office spaces

h. Cassette duplicating

i. Configuration management

APPENDIX B

FFSSC EQUIPMENT

This appendix delineates the equipment required by the FFSSC. The first section lists that equipment contained in the common shelter, while the second section lists associated equipment required to provide life-cycle maintenance support to FIREFINDER.

B.1 COMMON SHELTER EQUIPMENT

The following is a list of the common shelter equipment required for the FFSSC:

a. Integral computer, type HMP-3637A, containing 128K of memory, 16 I/O channels — 1

b. Weapons location unit, type ____, containing automatic plotting board, keyboard, drum, and switches — 1

c. B-scope indicator unit, type IP-1364/TPQ — 1

d. Line printer, type RO-524/TPQ — 1

e. Signal processor, type ____ — 1

f. Magnetic tape transport, type RD-458/TPQ — 2

g. Magnetic tape electronic unit, type MX-10128/TPQ — 1

h. Cartridge/printer controller, type ____ — 1

i. Radio set, type AN/VRC-46, containing 1 RT-524/VRC radio receiver transceiver — 2

B.2 ASSOCIATED EQUIPMENT

The type (nomenclature or model number) of equipment listed below is not firm and is only representative of that which will be required by the FFSSC. The EWL in conjunction with other programs should determine the type of equipment to be provided. A list and brief description of the associated equipment required by the FFSSC follow:

a. Computer set, type AN/UYK-15 or similar, containing a minimum of 64K of memory — 1: to be utilized for compiling the computer programs, scenario generation, and workload simulation

b. Software development panel, type HMP-3637A SDP — 1: to support the computer program development and maintenance functions

c. Firmware development station, type HMP-3637A FDS — 1: to support the updating/modifying/changing of the FIREFINDER firmware

d. Operator trainer console, type TPQ-36/37 — 1: used to check out modifications/changes/updates to the training software

e. Radar environmental simulator — 1, consisting of:

- Magnetic tape transports, Wangco Model 11 or similar — 3
- Minicomputer set, Data General Nova or compatible computer with floppy disc system — 1
- Target generator electronics — 1
- Clutter generator — 1
- Waveform generator, Pulse Coder I, and Pulse Coder II — 1
- IF converter — 1
- Interface, timing, and control electronics — 1
- Operator terminal — 1
- Junction box — 1
- Digital message device — 1
- Self-test panel — 1

f. Graphics display, type U-200 or similar — 1: control station for software development peripherals

g. Computer set, type HP-21MX or compatible, containing a minimum of 32K of memory — 1: to support the data reduction functions and the training software maintenance

h. Printer, line, type HP-2613A or similar — 1: computer program and data reduction listings

i. Card reader, type small and inexpensive — 1: to support computer program development

j. Magnetic tape unit and controller, type Kennedy 9100 or similar, 9-track, various BPI — 2: for history files, computer program development, and data reduction

k. Disk, type Kennedy 5300 or similar — 1: for storing scenarios and the computer programs for software development

l. Disk, type HP-7960A or similar — 1: to support data reduction and to provide sorting capability

m. Modem, type telephone — 1: to provide TACFIRE interface

B.3 ANTENNA-TRANSCEIVER EQUIPMENT

The major AN/TPQ-36 antenna-transceiver group equipment is as follows:

a. Boresight telescope assembly

b. Antenna

c. Transmitter

d. Beam steering synchronizer

e. Azimuth encoder

f. Tilt sensor

g. Receiver-exciter

The major AN/TPQ-37 antenna-transceiver group equipment is as follows:

a. Boresight telescope and illuminator

b. Tilt sensor

c. Antenna array

d. Transmitter

e. Receiver-exciter

f. Beam steering unit

g. Azimuth turntable assembly

B.4 OTHER EQUIPMENT

Other equipment required by the FFSSC includes all items needed in order to have completely functioning AN/TPQ-36 and AN/TPQ-37 radar systems. These items include cables, power distribution units, generators, and vehicles.

APPENDIX C

ACRONYMS

ABIC	Army Battlefield Interface Concept
ACSAC	Assistant Chief of Staff for Automation and Communications
ACSI	Assistant Chief of Staff for Intelligence
AGC	Automatic Gain Control
AMMH	Annual Maintenance Man-Hours
AMSAA	Army Materiel Systems Analysis Agency
APM	Assistant Project Manager
AR	Army Regulation
ARDIS	Army Research and Development Information System
ARTADS	Army Tactical Data Systems
ARTEP	Army Training Evaluation Program
ARTP	Advanced Resident Training Plan
ASARC	Army Systems Acquisition Review Council
ATE	Automatic Test Equipment
ATSS	Automatic Test Support Systems
ATU	Army Test Unit
BAMP	Battlefield Automation Management Plan
BAS	Battlefield Automated Systems
BIT	Built-in Test
BITE	Built-in Test Equipment
BOIP	Basis of Issue Plan
BOT	Beginning of Tape
BSI	Battlefield Systems Integration
BSU	Beam Steering Unit
BTA	Best Technical Approach
CAA	Concepts Analysis Agency
CACDA	Combined Arms Combat Development Activity
CAIG	Cost Analysis Improvement Group
CAR	Corrective Action Report
CDRL	Contract Data Requirements List
CENTACS	Center for Tactical Computer Systems
CERCOM	U.S. Army Communications and Electronics Materiel Readiness Command

ACRONYMS (Continued)

CLIN	Contract Line Item Number
CMO	Configuration Management Office
COA	Comptroller of the Army
COE	Chief of Engineers
COEA	Cost and Operational Effectiveness Analysis
COHO	Coherent Oscillator
CORADCOM	U.S. Army Communications Research and Development Command
CPCI	Computer Program Configuration Item
CPT	Comparison Test
CPU	Central Processing Unit
CRMP	Computer Resource Management Plan
CRT	Cathode Ray Tube
CRWG	Computer Resource Working Group
CSA	Chief of Staff, Army
CTA	Common Table of Allowance
CTP	Coordinated Test Plan
CTU	Cartridge Tape Unit
DA	Department of the Army
DACCS	Department of the Army Command and Control System
DARCOM	U.S. Army Materiel Development and Readiness Command
DASC	Department of the Army System Coordinator
DCN	Design Change Notice
DCSLOG	Deputy Chief of Staff for Logistics
DCSOPS	Deputy Chief of Staff for Operations and Plans
DCSPER	Deputy Chief of Staff for Personnel
DCSRDA	Deputy Chief of Staff for Research, Development, and Acquisition
DESCOM	U.S. Army Depot System Command
DID	Data Item Description
DLA	Defense Logistics Agency
DMA	Defense Mapping Agency
DMWR	Depot Maintenance Work Requirements
DP	Development Plan
DR	Data Reduction

ACRONYMS (Continued)

DS	Direct Support
DSA	Defense Supply Agency
DSARC	Defense Systems Acquisition Review Council
DSU	Direct Support Unit
DT	Development Test
DTP	Detailed Test Plan
DX	Data Extraction
ECP	Engineering Change Proposal
EER	Electronic Equipment Representative
EIA	Electronics Industrial Association
EIR	Equipment Improvement Recommendation
EIS	Environmental Impact Statement
EMRA	U.S. Army Electronics Materiel Readiness Activity
EOT	End of Tape
EPG	U.S. Army Electronic Proving Ground
EQUATE	Electronic Quality Assurance Test Equipment
ERADCOM	U.S. Army Electronics Research and Development Command
ERR	Engineering Release Record
EWL	Electronic Warfare Laboratory
FABD	U.S. Army Field Artillery Board
FAD	Force/Activity Designator
FAICCB	Field Artillery Interoperability Configuration Control Board
FAICWG	Field Artillery Interoperability Control Working Group
FAMAS	Field Artillery Meteorological Acquisition System
FAS	U.S. Army Field Artillery School
FATAB	Field Artillery Target Acquisition Battery
FATDS	Field Artillery Tactical Data Systems
FDTE	Force Development Testing and Experimentation
FEBA	Forward Edge of Battle Area
FF	FIREFINDER
FFCCB	FIREFINDER Configuration Control Board
FFR	FIREFINDER/REMBASS
FFSCCB	FIREFINDER Software Configuration Control Board
FFSSA	FIREFINDER Software Support Activity

ACRONYMS (Continued)

FFSSC	FIREFINDER Systems Support Center
FOE	Follow-on Evaluation
FORSCOM	U.S. Armed Forces Command
FSR	Field Service Representative
FYTP	Five-Year Training Plan
GFE	Government-Furnished Equipment
GFI	Government-Furnished Information
G/PD	Generator/Power Distribution
GS	General Support
GSU	General Support Unit
HAC	Hughes Aircraft Company
HFE	Human Factors Engineering
HQDA	Headquarters, Department of the Army
HQMC	Headquarters, U.S. Marine Corps
HZ	Hertz
ICP	Interface Change Proposal
ICT	Interchangeability Test
ID	Identification
IF	Intermediate Frequency
ILS	Integrated Logistics Support
IOC	Initial Operational Capability
IOTE	Initial Operational Test and Evaluation
IPR	In-Process Review
JINTACCS	Joint Interoperability Tactical Command and Control Systems
JITF	Joint Interface Test Force
K	1024
KIP	Key Instructor Personnel
KW	Kilowatts
LCSMM	Life-Cycle System Management Manual
LEA	U.S. Army Logistics Evaluation Agency
LFT	Live-Fire Test
LO	Local Oscillator
LOA	Letters of Agreement
LR	Letter Requirement

ACRONYMS (Continued)

LRIP	Low-Rate Initial Production
LSI	Large-Scale Integration
LSP	Logistics Support Plan
MAC	Maintenance Allocation Chart
MCDEC	U.S. Marine Corps Development and Education Command
MCF	Military Computer Family
MENS	Mission Element Need Statement
MILSTRIP	Military Standard Requisition and Issue Procedures
MN	Materiel Need
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOS	Military Occupational Specialty
MOU	Memorandum of Understanding
MRF	Maintenance Request Form
MSC	Major Subordinate Commands
MSI	Medium-Scale Integration
MST	Maintenance Support Team
MTBF	Mean Time Between Failure
MTBMA	Mean Time Between Maintenance Action
MTI	Moving Target Indicator
MTTR	Mean Time to Repair
MUL	Master Urgency List
MWO	Modification Work Order
NET	New Equipment Training
NICP	National Inventory Control Point
NMP	National Maintenance Point
NOR	Notice of Revision
NSP	Nonstandard Parts
OE	Operational Effectiveness
OFT	Operational Feasibility Testing
O&MA	Operational and Maintenance, Army
OMS/MP	Operational Mode Summary/Mission Profile
OPA	Other Procurement, Army
OPM	Office of Project Manager

ACRONYMS (Continued)

ORG	Organizational
OSUT	On-Site User Test
OT	Operational Test
OTEA	Operational Test and Evaluation Agency
OTP	Outline Test Plan
PAG	Project Advisory Group
PCA	Physical Configuration Audit
PDSS	Post-Deployment Software Support
PIP	Program Improvement Proposal/Program
PLL	Prescribed Load List
PM	Project Manager
PRF	Pulse Repetition Frequency
PUT	Programmed Unit Trainer
PVT	Production Validation Test; Performance Verification Test
RAM	Random Access Memory; Reliability, Availability, and Maintainability
RCM	Reliability Center Maintenance
RDT&E	Research, Development, Test and Evaluation
RES	Radar Environmental Simulator
RF	Radio Frequency
RFD	Request for Deviation
RFW	Request for Waiver
ROC	Required Operational Capability
RSMR	Radar Status Monitoring Routine
SA	Secretary of the Army
SAAD	Sacremento Army Depot
SAW	Surface Acoustic Wave
SLCMP	Software Life-Cycle Management Plan
SOP	Standard Operating Procedures
SPR	System Problem Report
STANAG	International Standardization Agreement
STC	Sensitivity Time Control
STE	Special Test Equipment
STF	Special Task Force
STR	Software Trouble Report
STSP	System Technical Support Plan

ACRONYMS (Continued)

TAA	Technology Assessment Annex
TACFIRE	Tactical Fire Direction System, Artillery
TAG	The Adjutant General
TAGO	The Adjutant General's Office
TAMMS	The Army Maintenance Management System
TCU	Tape Cartridge Unit
TDA	Table of Distribution and Allowances
TDR	Training Device Requirement
TECOM	U.S. Army Test and Evaluation Command
TIG	The Inspector General
TIWG	Test Integration Working Group
TM	Technical Manual
TMDE	Test, Maintenance, and Diagnostic Equipment
TOE	Table of Organization and Equipment
TPS	Test Program Set
TRADOC	U.S. Army Training and Doctrine Command
TSARC	Test Schedule and Review Committee
TSG	The Surgeon General
TWT	Traveling Wave Tube
USACDC	U.S. Army Combat Developments Command
USACSC	U.S. Army Computer Systems Command
USAEPG	U.S. Army Electronic Proving Ground
USAFAS	U.S. Army Field Artillery School
USAICS	U.S. Army Intelligence Center and School
USALEA	U.S. Army Logistics Evaluation Agency
USASA	U.S. Army Security Agency
UTM	Universal Transverse Mercator
V	Volts
V&V	Verification and Validation
VCSA	Vice-Chief of Staff, Army
VDD	Version Description Document
VFMED	Variable Format Message Entry Device
WBS	Work Breakdown Structure
WLU	Weapons Location Unit

APPENDIX D

REFERENCES/BIBLIOGRAPHY

D.1 INTRODUCTION

This appendix lists some of the reference material available for systems acquisition and support, specifically, software life-cycle support and management. These references are divided into five categories: (1) Standards, (2) Specifications, (3) DoD Directives and Instruction, (4) Army Regulations, Pamphlets, Circulars, Etc., and (5) Regulations, Orders, Reports, Etc. (Non-Army). The Systems Support Center staff should be familiar with as many of these references as possible, while remembering that new material is becoming available all the time. References marked with an asterisk (*) should be thoroughly reviewed by the FFSSC staff.

D.1.1 Standards

Standard	Title and Summary
MIL-STD-470 21 March 1966	Maintainability Program Requirements (For Systems and Equipment) Requires the contractor to establish and maintain an effective maintainability program integrated with the system/equipment design engineering program to assure effective, timely, and economical accomplishment. The program should be consistent with the type and complexity of systems/equipment and phase of development.
MIL-STD-480A 12 April 1978	Configuration Control — Engineering Changes, Deviations, and Waivers This standard provides the details imposed upon the contractor for preparation and submission of proposed engineering changes; deviations or waivers, including the technical, fiscal, and logistic supporting information of a proposed change; and requirements for maintaining configuration control of configuration items.
MIL-STD-482A 1 April 1974	Configuration Status Accounting Data Elements and Related Features Establishes data elements (including their related data items, codes, use identifiers) and data chains to be used as the content of configuration status accounting. Provisions are made for the addition of new programs or contractor data items.

Standard	Title and Summary
MIL-STD-483 31 December 1970 Change 1 June 1971	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs Establishes uniform configuration management practices that can be tailored to all systems and configuration items (including computer programs). Describes the general requirements of configuration management and outlines the content of documents pertinent to identifying, establishing, and controlling baselines.
*MIL-STD-490 30 October 1968 Change 18 May 1972	Specification Practices Establishes the uniform practices for specification preparation to ensure the inclusion of essential requirements, and to aid in the use and analysis of specification format and content for items, processes, and materials peculiar to the program. The applicable sets of specifications relating to computer programs are the type A (System Specification), type B5 (Computer Program Development Specification), and type C5 (Computer Program Product Specification).
MIL-STD-499A 1 May 1974	Engineering Management Provides criteria for evaluating engineering planning and output, task statements that may be selectively applied to an acquisition program, and a means for establishing an engineering effort and a System Engineering Management Plan.
MIL-STD-690B 17 April 1968 Change 1 August 1974	Failure Rate Sampling Plans and Procedures Provides procedures for FR qualification, sampling plans for establishing and maintaining FR levels at selected confidence levels, and lot conformance inspection procedures associated with FR testing for direct reference in an appropriate, established reliability specification for military electronic parts.

Standard	Title and Summary
MIL-STD-721B 25 August 1966 Change 10 March 1970	Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety This standard defines the words and terms used most frequently to specify effectiveness to give these terms a common meaning for DoD and defense contractors.
MIL-STD-876A 18 July 1971	Digital Computation Systems for Real-Time Training Simulators This standard covers the general characteristics and configurations of digital computation systems used in real-time training simulators and the general guidance for mathematical models.
MIL-STD-1521A 1 June 1976	Technical Reviews and Audits for Systems, Equipment, and Computer Programs This standard prescribes the requirements for the conduct of technical reviews and audits on systems, equipment, and computer programs. The following reviews/audits are described: System Requirements Review (SRR), System Design Review (SDR), Preliminary Design Review (PDR), Critical Design Review (CDR), Functional Configuration Audit (FCA), Physical Configuration Audit (PCA), and Formal Qualification Review (FQR).
*MIL-STD-1679 1 December 1978	Weapon System Software Development This standard establishes uniform requirements for the design and development of weapon system software. It contains requirements for design, program generation, QA, CM, subcontractor control, programming conventions, testing, program acceptance, and so forth. This standard also applies to firmware.

D.1.2 Specifications

Specifications	Title and Summary
MIL-S-52779(AD) 5 April 1974	Software Quality Assurance Program Requirements This specification requires the establishment and implementation of a Software Quality Assurance (QA) Program by the contractor. It defines the requirements of the Software QA Program as: work tasking and authorization procedures, configuration management, testing, corrective action, library controls, computer program design, software documentation, reviews and audits, and tools, techniques, and methodologies.
MIL-S-83490 30 October 1968	Specifications, Types, and Forms Identifies types and forms of specifications permitted. Prescribes general requirements for the preparation of specifications. All specifications must conform to MIL-STD-490 or DODM 4120.3M. Includes provisions for quality assurance of the specifications.

D.1.3 DoD Directives and Instructions

Directives/Instructions	Title and Summary
DIR 2010.6 11 March 1977	Standardization and Interoperability of Weapon Systems and Equipment Within the North Atlantic Treaty Organization (NATO) Establishes DoD policy and assigns DoD responsibilities. DOA is to consider NATO objectives, include in Decision Coordinating Paper (DCP) an analysis of how the program will contribute to NATO standardization, develop monitoring and inspection procedures to ensure compliance with ratified STANAGS, and establish close relationships with NATO for the definition of proposed new requirements and close collaboration in testing.

Directives/Instructions	Title and Summary
DIR 3100.4 27 September 1963	Harmonization of Qualitative Requirements for Defense Equipment of the United States and Its Allies Establishes DoD policy and assigns DoD responsibilities. DOA is to enhance interoperability and interchangeability of equipment, facilitate the goal of increased cooperation in research and development, and sponsor increased effectiveness of international logistics through greater standardization.
DIR 3200.11 18 June 1974	Use, Management, and Operation of Department of Defense Major Ranges and Test Facilities
DIR 4105.55 19 May 1972	Selection and Acquisition of Automatic Data Processing Resources Establishes DoD policies and guidance for the selection and acquisition of ADP resources (excludes computer equipment which is integral to a combat weapons system) and stresses the need for competitive selection, planning prior to acquisition, and review of all alternatives before making a selection.
DIR 4105.62 6 January 1976	Selection of Contractual Sources for Major Defense Systems
INSTR 4105.65 29 June 1970	Acquisition of Automatic Data Processing Computer Program and Related Services Establishes procedures to be used in defining requirements and developing purchase requests for the selection and acquisition of computer programs and related services (embedded tactical systems are excluded).
DIR 4120.3 6 June 1973	Department of Defense Standardization Program Establishes policies and assigns responsibilities for the DSP; establishes the Defense Materiel Specifications and Standards Board; and provides for the Defense Standardization Manual 4120.3M to disseminate procedures established in this directive. The DSP is to control item proliferation through the exercise of disciplines and procedures.

Directives/Instructions	Title and Summary
MAN 4120.3M 3 January 1972	Standardization Policies, Procedures, and Instructions Establishes the procedures and disciplines to implement the Defense Standardization Program as established by DoD DIR 4120.3.
DIR 4120.18 10 December 1976	Use of the Metric System of Measurement Establishes DoD policies for the use of the metric system. The metric system will be adopted where there is a specific military need (such as a program to be used jointly with NATO) and where there is potential for significant foreign sales.
DIR 4120.21 9 April 1977	Specifications and Standards Application Establishes the policies and procedures governing the application and tailoring of specifications and standards to achieve cost-effective acquisition and life-cycle ownership of defense materiel.
INSTR 4151.9 7 January 1975	Technical Manual (TM) Management
DIR 4155.1 9 February 1972	Quality Assurance Establishes DoD quality assurance policy. Quality assurance shall be optimally varied to assure mission responsiveness; a feedback system will be established, and quality audits will be conducted.
INSTR 4155.19 6 June 1978	NATO Quality Assurance
DIR 4160.19 5 April 1973 Change 15 May 1974	Department of Defense Automatic Data Processing Equipment Reutilization Program Prescribes policies and assigns responsibilities and authorities governing the DoD ADPE reutilization program. Establishes DoD Manual 4160.19-M as a regulation.

Directives/Instructions	Title and Summary
DIR 4630.5 28 January 1967	Compatibility and Commonality of Equipment for Tactical Command and Control and Communications Establishes DoD policy and procedures to ensure that tactical command and control and communications equipment possess essential compatibility and commonality required for joint military operations.
INSTR 5000.XX	Interim List of DoD Approved Architectures
DIR 5000.XX	Acquisition of Support Systems for Command and Control
DIR 5000.1 18 January 1977	Major System Acquisitions Implements OMB Circular A-109 and updates DoD policy for the management of major system acquisitions. Identifies the phases and requirements for each decision point. DIR 5000.1 and 5000.2 are presently combined in DIR 5000.1 Draft of 31 August 1978.
DIR 5000.2 18 January 1977	Major System Acquisition Process Supplements DoD DIR 5000.1 with policies and procedures. Establishes DSARC, ASARC, MENS, and DCP and their content.
*DIR 5000.3 11 April 1978	Test and Evaluation Establishes policy for the conduct of test and evaluation in the acquisition of defense systems. Establishes requirements for DT&E, OT&E, TEMP, and so forth. States: "In each DoD component there will be one major field agency separate and distinct from the developing/procuring command and the using command which will be responsible for OT&E." T&E shall be scheduled in the acquisition, shall begin early, and continue throughout the acquisition in an effort to identify and reduce technical risk. Section on computer software states that software is subject to the same formal DT/OT as hardware.

Directives/Instructions	Title and Summary
DIR 5000.9 28 February 1978	Standardization of Military Terminology Establishes the use of JCS Pub 1, DoD Dictionary of Military and Associated Terms, as the standard military terminology throughout DoD.
DIR 5000.11 7 December 1964	Data Elements and Data Codes Standardization Program Specifies objectives, policies, and responsibilities. DOA is to use DoD standard data elements and data codes to the maximum extent possible.
INSTR 5000.12 27 April 1965	Data Elements and Data Codes Standardization Procedures Establishes policies, procedures, explanation of terms, and criteria for identifying, developing, coding, and maintaining standard data elements and their related data items, codes, and use identifiers.
INSTR 5000.18 17 March 1969	Implementation of Standard Data Elements and Related Features Establishes policies and procedures for implementation of standard data elements and related features in DoD data systems.
DIR 5000.19 12 March 1976	Policies for the Management and Control of Information Requirements Establishes uniform policies and criteria for use in the management, control, and registration of internal and interagency information requirements, public reporting requirements, and the resulting information or reporting system. Objectives are to prevent the establishment of duplicative information requirements and assure optimum effectiveness and economy in the flow of information.
INSTR 5000.22 17 October 1974	Guide to Estimating Costs of Information Requirements Transmits GSA "Guide to Estimating Reporting Costs."

Directives/Instructions	Title and Summary
DIR 5000.28 23 May 1975	Design to Cost
*DIR 5000.29 26 April 1976	Management of Computer Resources in Major Defense Systems Establishes policy for the management and control of computer resources during the development, acquisition, deployment, and support of major defense systems. Establishes Management Steering Committee for Embedded Computer Resources. DOA is to develop and implement a disciplined approach to the management of software design, engineering, and programming.
INSTR 5000.31 24 November 1976	Interim List of DoD Approved High Order Programming Languages (HOL's) Establishes the HOL's as CMS-2, SPL-1, TACPOL, JOVIAL, COBOL, and FORTRAN.
INSTR 5000.33 15 August 1977	Uniform Budget/Cost Terms and Definitions Establishes uniform budget/cost terms for use in the management of weapon/support systems. Identifies cost categories, work breakdown structure elements, and the appropriations associated with each cost term.
DIR 5000.34 31 October 1977	Defense Production Management Establishes policy and responsibility for production management during defense system and equipment acquisition.
DIR 5000.35 8 March 1978	Defense Acquisition Regulatory System Establishes policy and procedures for the management and operation of the DoD acquisition regulatory system (DARS). DARS is a system of policies and regulations to guide managers in the conduct of acquisition activities and to provide the detailed functional regulations required to govern contractual actions. DARS policy and procedures shall be published in the Defense Acquisition Regulation (DAR), and in DoD Directives, Instructions, Circulars, and Manuals. DAR replaces ASPR. ASPR is redesigned as the DAR.

Directives/Instructions	Title and Summary
DIR 5010.8 12 May 1976	DoD Value Engineering Program
DIR 5010.19 17 July 1968 Change 7 April 1970	Configuration Management Establishes DoD policy for configuration management (CM). CM must be applied to all configuration items procured.
INSTR 5010.21 6 August 1968 Change 29 January 1969	Configuration Management Implementation Guidance Provides guidance for the implementation of DoD DIR 5010.19. Applies to all systems, equipment, and other designated material items. Defines change classification, configuration audits, and so forth.
INSTR 5010.27 9 November 1971	Management of Automatic Data System Development Establishes uniform guidelines for managing the development of automatic data systems administration.
DIR 5010.28 2 October 1972	Department of Defense Management Review and Improvement Program
*INSTR 5030.40 27 March 1969 Change 5 July 1972	Government-Wide ADP Sharing Program Establishes policies and procedures governing the utilization of ADP resources by means of participation in the Government-Wide ADP Sharing Program operated by GSA.
DIR 5100.40 19 August 1975	Responsibilities for the Administration of the DoD Automatic Data Processing Program Governs the DoD ADP program (except for command, control, and communications systems).
INSTR 5100.66 7 January 1975	Establishment of Policy for, and Administration of, Independent Research and Development Programs (IR&D)
DIR 5100.73 11 April 1975	Department of Defense Management Headquarters

Directives/Instructions	Title and Summary
DIR 5105.40 1 January 1972	Defense Mapping Agency (DMA) Establishes the DMA with the mission to provide support to DoD and DoD components on matters concerning mapping, charting, and geodesy (MC&G).
DIR 5118.3 11 July 1972	Assistant Secretary of Defense (Comptroller)
INSTR 7000.2 10 June 1977	Performance Measurement for Selected Acquisitions
INSTR 7000.3 23 September 1975	Selected Acquisition Reports (SAR)
DIR 7000.13 26 April 1976	Inflation Impact Statements Implements OMB A-107 and prescribes policy and guidelines for the identification and evaluation of the inflationary impact of major proposals, which are not part of the normal budget review process.
INSTR 7041.3 18 October 1972	Economic Analysis and Program Evaluation for Resource Management Establishes policy and procedures for consistent application of economic analysis for tradeoff comparison.
INSTR 7045.7 29 October 1969	The Planning, Programming, and Budgeting System
INSTR 7045.8 11 December 1969	Procedures for Updating Program Data in the Five-Year Defense Program (FYDP)
INSTR 7935.1 13 September 1977	DoD Automatic Data Systems Documentation Standards Establishes DoD Standard 7935.1-S as the basis for documentation of all ADP projects.
STD 7935.1-S	DoD Automated Data Systems (ADS) Documentation Standards Establishes the basis for documentation of all ADS projects. Designed to facilitate continuing improvements and timely responsiveness to evolving technology. Redocumentation of an existing ADS to meet these requirements is only required when major system changes to the ADS are accomplished.

D.1.4 Army Regulations, Pamphlets, Circulars, Etc.

Regulations/Pamphlets	Title and Summary
AR 1-1 25 May 1976	Planning, Programming, and Budgeting within the Department of the Army Establishes the Army PPBS and assigns responsibilities. Describes the relationship of Army PPBS actions to the PPBS actions of SECDEF.
AR 5-5 5 July 1977 DARCOM Suppl 30 September 1977 CERCOM Suppl 24 March 1978	The Army Study System
AR 10-4 30 December 1974	U.S. Army Operational Test and Evaluation Agency Sets forth the mission and principal functions of OTEA. OTEA is to support the materiel acquisition and force development processes by exercising responsibility for all OT and managing FDTE. OTEA is to actively participate in the conduct of and provide independent evaluation of OT conducted on major systems.
AR 10-5 1 April 1975	Department of the Army Sets forth the organization and functions of DA and the general responsibilities of the heads and commanding generals of its major elements.
AR 10-6 17 June 1970	Branches of the Army
AR 10-8 24 February 1978	U.S. Army Computer Systems Selection and Acquisition Agency Sets forth the mission and functions of USA CSSAA. Serves as primary agency for the development of solicitation documents, evaluation of vendor responses, and competitive selection and acquisition of ADPE.

Regulations/Pamphlets	Title and Summary
AR 10-9 15 December 1978	United States Army Computer Systems Command Sets forth the mission and functions of the USACSC in its responsibilities for Army multicommand standard automatic data processing systems.
*AR 10-11 9 March 1977	United States Army Materiel Development and Readiness Command Prescribes the mission and principal functions of CG, DARCOM, and sets forth command and staff relationships with higher and collateral headquarters. DARCOM is under the supervision of the Chief of Staff, U.S. Army.
AR 10-25 1 August 1978	U.S. Army Logistics Evaluation Agency
*AR 10-41 27 June 1973	United States Army Training and Doctrine Command Prescribes the mission and principal functions of TRADOC and sets forth command relationships. The mission is to develop and manage training programs; conduct combat developments; and guide, coordinate, and integrate the total combat development effort.
AR 10-47 12 August 1974	U.S. Army Command and Control Support Agency Sets forth the organization and functions of the USACCSA as a staff support agency of DCSOPS and prescribes for requesting services, documentation, and data.
AR 11-4 13 January 1975	System Program Reviews
*PAM 11-5 3 May 1976	Standards for Presentation and Documentation of Life-Cycle Cost Estimates for Army Materiel Systems
AR 11-8 18 March 1976 Change 24 February 1978	Principles and Policies of the Army Logistics System

Regulations/Pamphlets	Title and Summary
PAM 11-13 10 March 1975	Army Electromagnetic Compatibility Program Guide
AR 11-14 15 July 1978	Logistics Readiness
PAM 11-25 21 May 1975	Life-Cycle System Management Model for Army Systems Promulgates the LCSMM for Army materiel systems. Outlines general procedures for their development and acquisition. Describes briefly the total life cycle.
AR 11-26 30 June 1972	Value Engineering
AR 15-14 1 April 1978	Systems Acquisition Review Council Procedures Provides guidance and establishes membership and procedures governing ASARC. Contains checklists for Milestones I, II, and III and a DCP outline.
AR 15-21 4 May 1977	Army Command and Control Council
AR 18-1 22 March 1976	Policies, Objectives, Procedures, and Responsibilities Describes objectives, prescribes policies and procedures, and assigns responsibilities for the formulation, design, development, testing, evaluation, installation, operation, maintenance, and review of Army Management Information Systems (AMIS). Prescribes policies and responsibilities concerning management of Army tactical data systems and tactical automated communication systems.
PAM 18-4 26 December 1973 Change 24 January 1975	Data Processing Installation Review/ Evaluation Checklist Contains a checklist designed to assist DPI managers in achieving efficient and economical operations, and to aid review teams in their conduct of on-site reviews of DPI operations.

Regulations/Pamphlets	Title and Summary
PAM 18-8 16 February 1977	A Software Resource Macroestimating System Provides an improved basis for projecting the out-year resource requirements of Army system design efforts. Enables users to forecast the size of new software projects.
AR 34-1 5 April 1974	United States Participation in NATO Military Standardization Research, Development, Production, and Logistics Support of Military Equipment
AR 37-18 15 October 1971	Weapon/Support Systems Cost Categories and Elements Establishes weapon/support life-cycle cost structures and definitions of cost elements or categories to be used by cost analysis activities of DA.
AR 37-19 27 December 1974	Financial Administration of Interservice and Interdepartment Support Agreement Applies on a worldwide basis to situations in which an activity of the Department of the Air Force, Army, or Navy provides facilities or continuing support to an activity of another military department.
AR 37-49 15 October 1978	Budgeting, Funding, and Reimbursement for Base Operations Support of Army Activities Prescribes the budgeting, funding, and reimbursement policies and responsibilities to be followed by Army activities in connection with intra-Army base operations support. Applies in cases where one Army activity provides base operations support to another Army activity. States requirements for support agreements.
AR 37-112 15 February 1973 Change 5 February 1976	Management Accounting for the RDTE Appropriation
*TM 38-750 15 May 1978	The Army Maintenance Management System (TAMMS) Prescribes the equipment record procedures for controlling the operation and maintenance of Army materiel. Contains descriptions and procedures for use, preparation, and disposition of TAMMS forms and records.

Regulations/Pamphlets	Title and Summary
*AR 70-XX 1 October 1978	Management of Computer Resources in Army Battlefield Systems Implements DoD DIR 5000.29. Establishes policy and assigns responsibilities for the planning, development, acquisition, testing, training, utilization, and support of Army battlefield systems. States the requirements for and contents of the Computer Resource Management Plan as an annex to the System Acquisition Plan. Requires a Software Configuration Control Board and specifies software as a configuration item.
AR 70-1 1 May 1975 Change 15 February 1977	Army Research, Development, and Acquisition Establishes responsibilities, policy, and procedures for conducting R&D, acquiring developmental and nondevelopmental items or systems, and conducting developmental product improvements. Implements DoD DIR 5000.1 and AR 1000-1. DARCOM is responsible for acquisition and logistic support of materiel, systems, or techniques (within assigned areas). In conjunction with TRADOC, it is responsible for developing advanced materiel concepts. TRADOC directs combat development activities and recommends to HQDA materiel development objectives, materiel requirements for theatre, Army, and training devices. Defines system acquisition process.
*AMCP 70-4 2 September 1974	Research and Development Software Acquisition - A Guide for the Materiel Developer Intended to assist the materiel developer in required statements and expeditious review. Outlines the software acquisition process for a tactical data system. Contains a model statement of work, schedule, CDRL, software design standard, and software test standard.
AR 70-4 10 October 1968	Standardization among Armies of United States, United Kingdom, Canada, and Australia

Regulations/Pamphlets	Title and Summary
AR 70-6 12 November 1974 DARCOM Suppl 2 December 1976	Management of the Army Research, Development, Test, and Evaluation (RDTE) Appropriation Prescribes procedures for development, control, and execution of the RDTE appropriation and establishes policies for reprogramming.
CIR 70-6	Standard Terminology for Department of the Army Program Reviews
AR 70-9 3 October 1968 Change 22 August 1973 AMC Suppl 30 September 1974	Army Research and Development Information System Program Planning and Ongoing Work Reporting Provides specific instruction for preparing and submitting R&D planning summary data and general guidance pertaining to reporting of R&D technical and management information at the project and task area levels.
AR 70-10 29 August 1975	Test and Evaluation during Development and Acquisition of Materiel Assigns responsibilities, establishes policies, and prescribes procedures for test and evaluation. Implements DoD DIR 5000.3 and AR 1000-1. Applies primarily to development testing and operational testing. DT is the responsibility of the materiel developer. OT is the responsibility of OTEA (for major) or TRADOC (for nonmajor). Describes goals, supportive testing, DT, OT, test administration and funding, and other testing activities.
AR 70-11 15 July 1968	Defense Documentation Center for Scientific and Technical Information (DDC) Establishes policy, assigns responsibilities, and prescribes procedures for DA support and use of the facilities of DDC. DDC is to provide timely, effective, and efficient bibliographic processing, announcement, and secondary distribution of technical reports and documents.

Regulations/Pamphlets	Title and Summary
AR 70-15 1 April 1975	Product Improvement of Materiel Establishes policy and assigns responsibility for product improvement of standard and limited production and Army material. Provides criteria and instructions.
AR 70-16 20 March 1975	Department of the Army System Coordinator (DASC) System Establishes policies, responsibilities, and procedures for DASC System. DASC will function as the HQDA point of contact for all aspects of system development and acquisition and to coordinate the status of all events in the LCSMM.
AR 70-17 11 November 1976	System/Program/Project/Product Management Establishes procedures and assigns responsibilities governing the use and application of centralized management of programs designated as impacting the fundamental national interests or redirected national policy.
AR 70-21 5 May 1977	Certification and Registration for Access to DoD Scientific and Technical Information Establishes procedures whereby DoD components and their contractors may become certified and registered for access to controlled scientific and technical information (STINFO).
PAM 70-21 10 May 1976	The Coordinated Test Program (CTP)
AR 70-27 17 March 1975	Outline Development Plan/Development Plan/Army Program Memorandum/Defense Program Memorandum/Decision Coordinating Paper Prescribes policy, procedures, and content for ODP, DP, APM, DPM, and DCP.
AR 70-31 9 September 1966 Change 15 January 1971	Standards for Technical Reporting Prescribes policy, responsibility, procedures, and standards governing the preparation, review, production, and distribution of DA technical reports.

Regulations/Pamphlets	Title and Summary
AR 70-32 20 March 1969	Work Breakdown Structures for Defense Materiel Items
AR 70-41 3 January 1974	Cooperation with Allies and Other Nations in Research and Development of Defense Equipment
*AR 70-37 1 July 1974 DARCOM Suppl 18 August 1976	Configuration Management Prescribes uniform policies and guidance for configuration management (CM). CM shall be carefully tailored to the quantity, size, scope, stage of life cycle, nature, and complexity of a configuration item. Supplement details CM requirements, format for CMP, definitions, engineering release record, ECP processing, cost factors, procedures for computer programs, audits, SOW's, and status accounting.
AR 70-55 18 May 1970 AMC Suppl 18 May 1972	Management of U.S. Army Research and Development Centers and Laboratories Sets forth policies, responsibilities, and procedures for the management of R&D centers and laboratories in order to ensure the effective utilization of R&D resources.
AR 70-59 2 November 1977	Department of Defense Tactical Shelter Program Establishes the policy, procedures, organization, and responsibilities for a research, development, and engineering (RD & Eng) program. This program is intended to reduce duplication, achieve standardization, meet requirements, and upgrade military shelters program.
AR 70-61 1 August 1978	Type Classification of Army Materiel Establishes policies, prescribes procedures and responsibilities, and outlines the process to identify and record the life-cycle status of a materiel system.
AR 71-2 19 April 1976	Basis of Issue Plans

Regulations/Pamphlets	Title and Summary
AR 71-3 8 March 1977	User Testing Establishes policies and procedures and assigns responsibilities for initiating, planning, programming, conducting, and reporting user testing; governs OT and FDTE.
AR 71-5 1 July 1969	Introduction of New or Modified System/Equipment Prescribes policies and procedures commands and agencies will follow to ensure that the Army has trained and qualified personnel to operate and maintain new or modified systems and equipment; assigns responsibilities.
AR 71-9 7 February 1975 ERADCOM Suppl 1	Materiel Objectives and Requirements Establishes procedures and assigns responsibilities for formulating and processing requirements documentation for acquisition of materiel from the time of inception to initiation of production and deployment.
PAM 210-1 25 April 1977	United States Army Installations and Major Activities
PAM 310-1 1 October 1979	Index of Administrative Publications
PAM 310-3 1 September 1978	Index of Doctrinal, Training, and Organizational Publications
AR 310-25 15 September 1975	Dictionary of United States Army Terms Contains terms and definitions for use throughout the U.S. Army in order to assist in reaching a more common understanding of the meaning of terminology used extensively by the U.S. Army. States that terms designated by "A" will not be defined otherwise in Army publications, nor will they be repeated in other Army publications.
AR 310-31 2 September 1974	Management System for Table of Organization and Equipment (The TOE System)

Regulations/Pamphlets	Title and Summary
AR 310-34 24 February 1975 Change 1 June 1978 AMC Suppl 4 September 1975 DARCOM Suppl 25 April 1975	Equipment Authorization Policies and Criteria, and Common Tables of Allowances Prescribes the policies and guidance for the inclusion of equipment in TOE. Describes the documents which are used to establish requirements for and authorize equipment to units and/or individuals, and/or make reference to other appropriate regulations.
AR 310-50 3 November 1975 Change 8 April 1977	Authorized Abbreviations and Brevity Codes
AR 525-1 20 January 1971	The Department of the Army Command and Control System (DACCS) Prescribes and describes the policy, objectives, procedures, and organization of DACCS as being a subsystem of WWMCCS and is designed to support the concept of WWMCCS operations.
AR 602-1 1 June 1976 ECOM Suppl 24 March 1977 ERADCOM Suppl 25 January 1978	Human Factors Engineering Program
AR 611-201 1 October 1973 Change 15 June 1978	Enlisted Career Management Fields and Military Occupation Specialists
AR 700-1 7 June 1977	Army Conversion to the Metric System of Measurement (International System of Units) (SI)
AR 700-2 25 March 1977	Defense Logistics Agency (DLA)
AR 700-18 21 September 1973	Provisioning of U.S. Army Equipment Sets forth basic principles, objectives, and policies, and assigns responsibilities for provisioning for the initial support of Army systems and end items.
AR 700-70 18 October 1977	Specifications and Standards Application

Regulations/Pamphlets	Title and Summary
AR 700-74 27 October 1969	Interservice (Depot) Maintenance Interrogation System (ISMIS)
AR 700-127 11 April 1975	Integrated Logistic Support Establishes policy for integrating life-cycle logistics support considerations into the materiel acquisition process and implements DoD Directive 4100.35.
AR 700-129 11 January 1980	Integrated Logistics Support Management of Multiservice Communications-Electronics Systems and Equipment
AR 702-3 15 November 1976 DARCOM Suppl 4 May 1978	Army Materiel Reliability, Availability, and Maintainability (RAM) Sets forth objectives, concepts, responsibilities, and general policies for Army RAM programs. Establishes the manner by which RAM characteristics are to be stated in requirements, designed into systems, used in the design of support systems, and assessed throughout the life cycle.
AR 702-9 7 March 1977	Production Testing of Army Materiel Prescribes the objectives, policies, and responsibilities for testing Army materiel during the production phase.
AR 702-10 29 July 1977	Post-Production Testing of Army Materiel Prescribes the objectives, concepts, policies, and responsibilities for testing of Army material during the post-production phase of the materiel life cycle.
AR 710-18 20 January 1978	Provisioning of U.S. Army Equipment
PAM 750-XX April 1978	Guide to Reliability Center Maintenance (RCM) for Fielded Equipment
AR 750-1 1 April 1978	Army Materiel Maintenance Concepts and Policies Sets forth concepts, objectives, principles, and policies, and assigns responsibilities. Establishes requirements and provides guidance for the management and performance of

Regulations/Pamphlets	Title and Summary
AR 750-1 (Continued)	the materiel management function. Covers the maintenance engineering and the maintenance operation subfunctions of the materiel-maintenance function of the Army Logistic System.
AR 750-4 2 June 1976	Depot Materiel Maintenance and Support/ Training Activities
AR 750-10 1 June 1977	Modification of Materiel
PAM 750-19 31 October 1973	Quality Management for Direct Support/ General Support Maintenance Operations
AR 750-21 20 February 1974	DA Equipment Maintenance Management Program
AR 750-37 24 March 1971 AMC Suppl 21 February 1975	Sample Data Collection for The Army Maintenance Management System (TAMMS) Sets forth concepts, objectives, responsibilities, and general policy for TAMMS. Supplements TM 38-750.
*AR 750-43 24 July 1975 DARCOM Suppl 18 February 1976 ECOM Suppl 8 October 1975	Test, Measurement, and Diagnostic Equipment (Including Prognostic Equipment and Calibration Test/Measurement Equipment) Prescribes policies, establishes objectives and priorities, and assigns responsibilities for the life-cycle management of TMDE, including ATE.
AR 750-51 30 July 1976	Maintenance Assistance and Instruction Team (MAIT) Program Prescribes policy and procedures for the MAIT program, and provides guidance and direction for its operation. Provides a means whereby technical experts can be furnished individual unit commanders to help them identify and solve problems.
AR 1000-1 1 April 1978	Basic Policies for Systems Acquisition Establishes basic Army policy for acquisition of materiel systems and implements DoD Directives 5000.1 and 5000.2.
AR 1000-2 17 January 1977	Operating Policies for Systems Acquisition by the DA

Regulations/Pamphlets/	Title and Summary
*DARCOM-R 70-16 16 July 1979	Management of Computer Resources in Battlefield Automated Systems
*DARCOM-C 702-4 28 March 1978	Army Defense Systems Software Control During the Production and Deployment Plan Presents the DARCOM policy governing Army Defense Systems Software change control and the release of new versions during the production and deployment phase. States that all changes come under the cognizance of and will be fully documented by the SCCB (chaired by the Materiel Developer Proponent). Requires a Computer Resource Management Plan as an annex to the System Acquisition Plan.
ERADCOM-R-702-2 22 February 1978	Contractual Reliability, Availability, and Maintainability (RAM) Requirements for ERADCOM Materiel
CACDA 27 September 1978	Army Battlefield Interface Concept, Final Draft
CACDA 1 July 1978	Battlefield Automation Management Plan
*PM, TACFIRE/FATDS 13 March 1979	Field Artillery Interoperability Configuration Management Plan
*CORADCOM 1 March 1979	Post-Deployment Software Support (PDSS) Management Plan

D.1.5 Regulations, Orders, Reports, Etc. (Non-Army)

Regulations (Non-Army)	Title and Summary
USMC DCO P3560.1	Technical Management of Tactical Computer Program Procurement
AFR 80-14 19 July 1976	Test and Evaluation
AFR 800-2 14 November 1978	Acquisition Program Management
AFR 800-14 (Vol. I) 12 September 1975	Management of Computer Resources in Systems

Regulations (Non-Army)	Title and Summary
AFR 800-14 (Vol. II) 26 September 1975	Acquisition and Support Procedures for Computer Resources in Systems
TADSTAND 9 8 August 1978	Software Quality Testing Criteria Standard for Tactical Digital Systems
SECNAVINST 3560.1 8 August 1974	Department of the Navy Tactical Digital Systems Documentation Standards
EIA 8 January 1979	Final Report on Panel G Activities, Electronics Industrial Association (EIA)

APPENDIX E

FIREFINDER RADAR SYSTEM

E.1 GENERAL

The FIREFINDER radar system consists of the AN/TPQ-36 Mortar Locating Radar and the AN/TPQ-37 Artillery Locating Radar. Both radars use a combination of phased-array radar techniques and computer-controlled signal processing to detect, verify, and track projectiles in flight. The track data are then used to define a trajectory that is extrapolated back to the location of the weapon firing the projectile. The location of the weapon, with computer provided altitude correction, is provided to the Artillery Fire Direction Centers within seconds of the detected projectile firing. The electronically steerable phased-array antennas allow the radars to continue searching for new targets while tracking, locating, and simultaneously handling multiple weapon location firings.

E.2 AN/TPQ-36 MORTAR LOCATING RADAR

The AN/TPQ-36 is a highly mobile, tactical radar system that can be deployed close to the forward edge of the battle area (FEBA) with direct support artillery battalions. The radar is designed to automatically locate short-range mortars, artillery, rockets, and other high-angle fire weapons. Its automation provides it with the capability of locating weapon firings simultaneously from multiple positions. In addition, the radar can be used to register and adjust friendly fire.

The mortar locating radar consists of an S-250 Common Operations Shelter carried on an M-561 Gama Goat and the antenna trailer assembly pulled by the Gama Goat (see Figures E-1 and E-2). Power for the system is provided by a 10-kW, 400-Hz turbine generator, which is carried on the antenna trailer. The trailer assembly also includes the antenna array and associated electronics, the

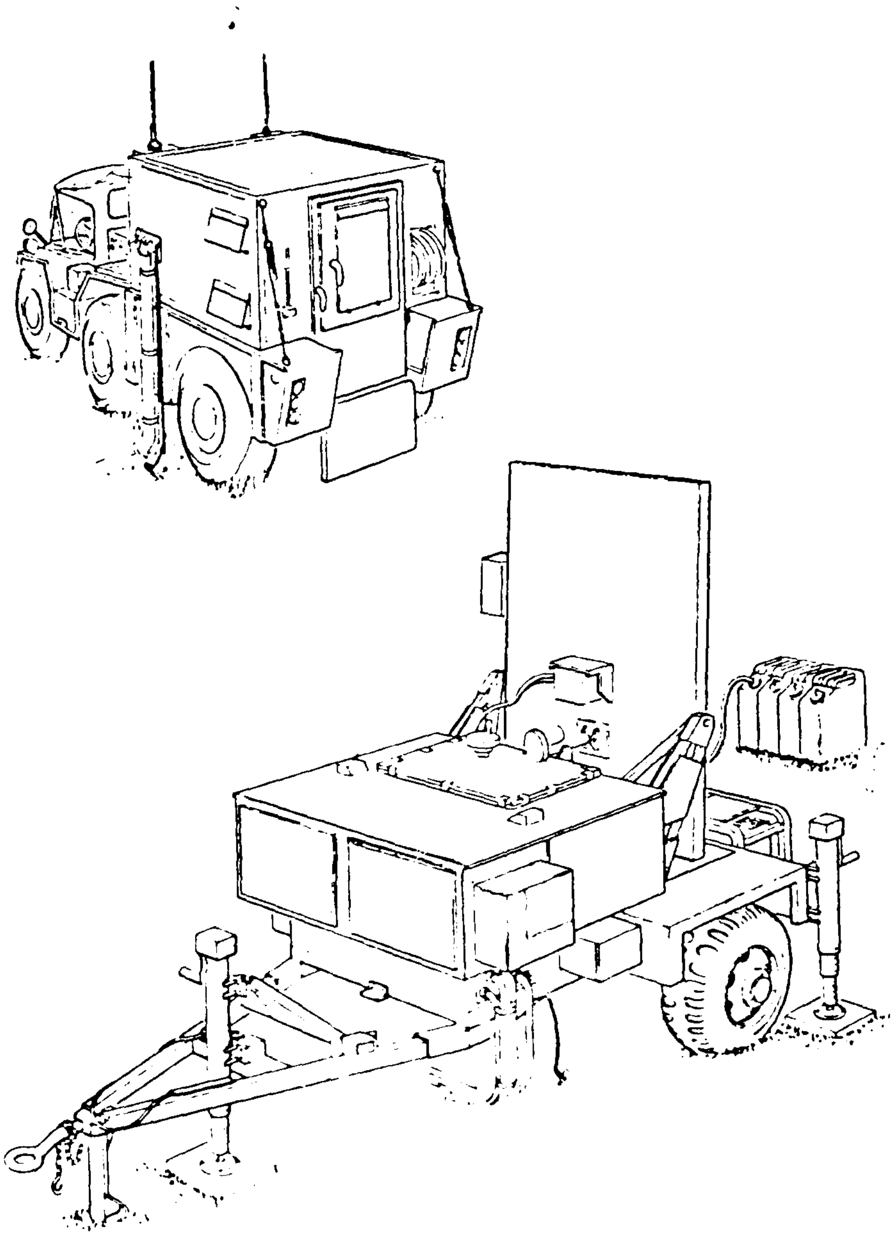


Figure E-1. AN/TPQ-36 Radar Set Elements

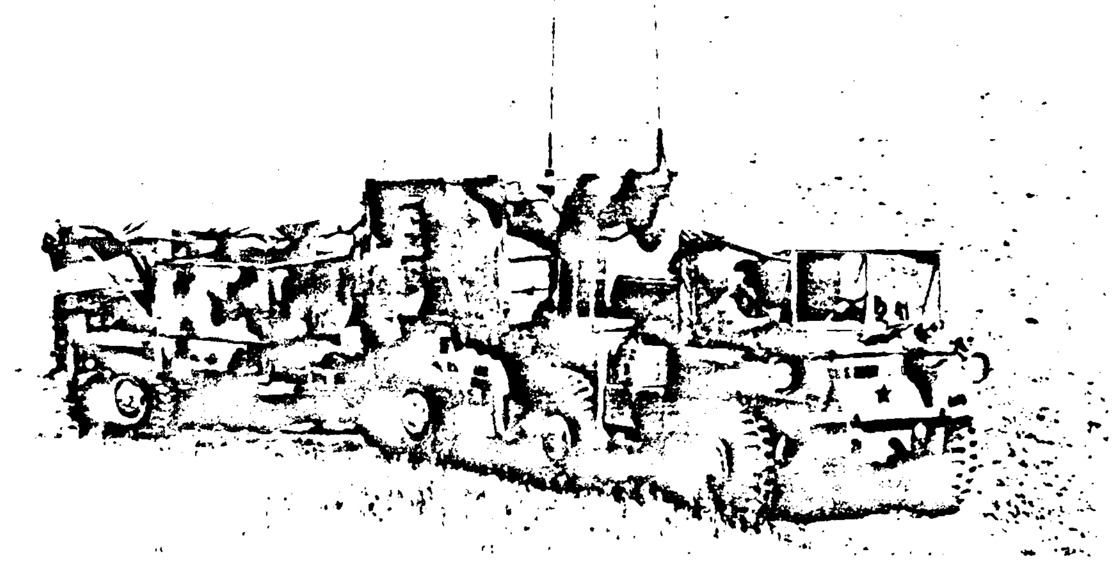


Figure E-2. AN/TPQ-36 System in Transport Configuration

transmitter, and a major portion of the receiver. The S-250 Common Operations Shelter provides space for the operator of the radar and includes the majority of the data processing hardware. The shelter and the antenna trailer can be transported by the CH-47 helicopter. Figure E-3 contains a functional block diagram of the AN/TPQ-36.

The AN/TPQ-36 will be organic to each direct support artillery battalion within the division and will be assigned to the target acquisition battery of armor, infantry, and mechanized infantry divisions. A joint Memorandum of Agreement (MOA) was signed by the U.S. Army and the U.S. Marine Corps to develop and procure the AN/TPQ-36.

E.2.1 Antenna-Transceiver Group

The antenna-transceiver group consists of a 3/4-ton trailer and the antenna-transceiver assembly mounted on the trailer. Also mounted on the trailer is the 10-kW generator, trailer power distribution assembly, trailer connector panel,

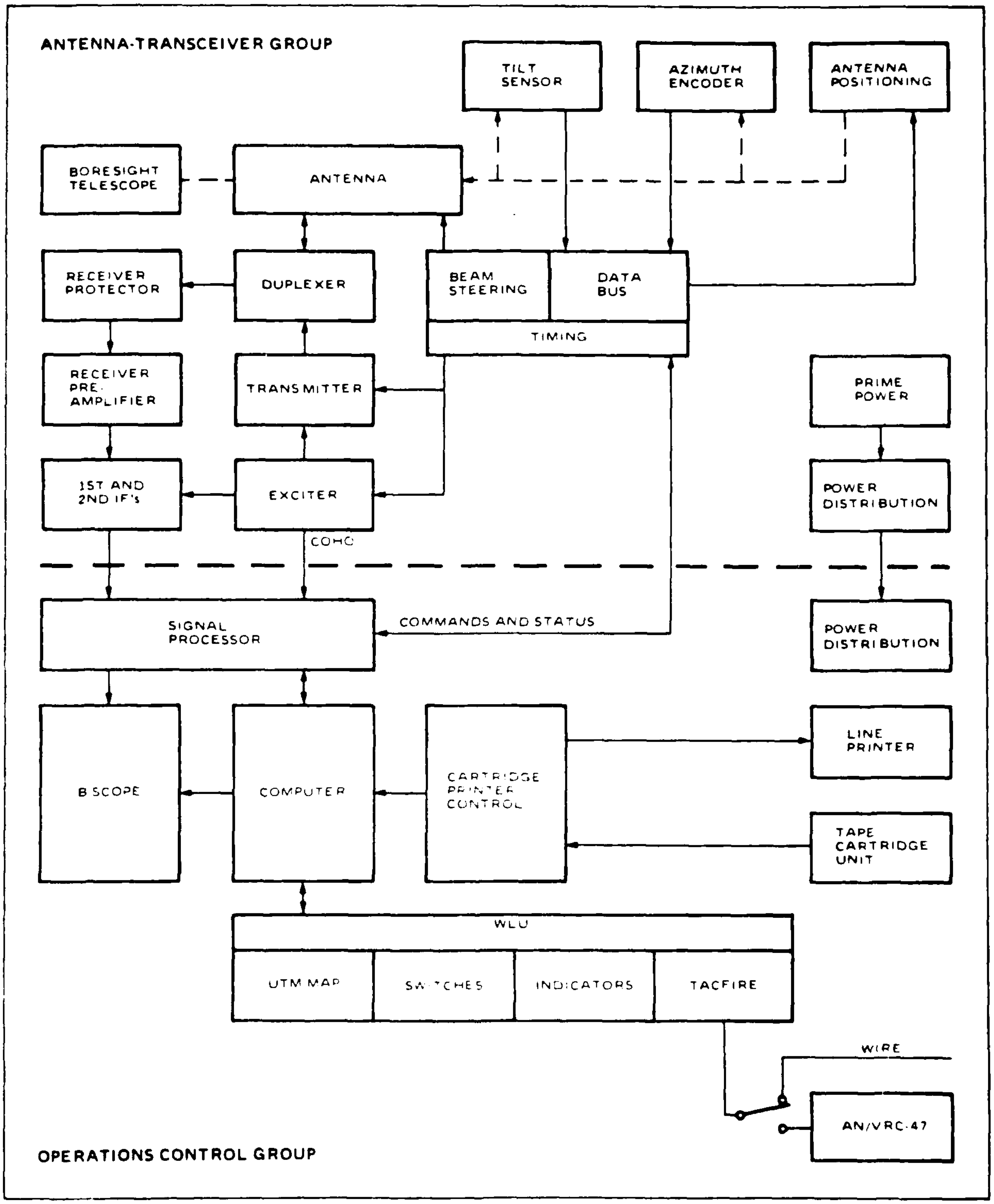


Figure E-3. Simplified System Block Diagram of AN/TPQ-36 telephone set, and three leveling jacks. When the system is operational, the trailer is supported by the leveling jacks (see Figure E-4).

The antenna-transceiver assembly is composed of the radar antenna group and the radar-transceiver group.

The radar antenna group is mounted on the forward edge of the radar-transceiver group. The antenna group is composed of the radar antenna, telescope boresight assembly, tilt sensor, antenna elevation assembly, and the synchronizer and beam steering assembly. The telescope boresight assembly is mounted on the left side of the antenna. The tilt sensor is mounted on the back of the antenna. The antenna elevation assembly is mounted on the front of the radar transceiver compartment. The synchronizer and beam steering assembly is mounted at the bottom rear of the antenna and contains a blower assembly, five power supplied, an air filter, card rack, and a connector panel.

The radar-transceiver group contains three peripheral compartments and one central compartment. The central area contains the azimuth drive compartment. The curb-side compartment contains the receiver-exciter assembly. The rear compartment houses the transmitter amplifier and high-voltage subassembly, while the roadside compartment contains the transmitter low-voltage subassembly. The planar array antenna phase-scans in azimuth and frequency-scans in elevation. A linear feed distributes the input power to each of the 64 phase shifters, using a Taylor distribution to achieve 25dB peak design azimuth sidelobes. The 64 linear arrays fed by the phase shifters are slotted waveguides.

E.2.2 Operations Control Group

The Operations Control Group, OK-398/TPQ, is contained in the electrical equipment S-250 Common Operations Shelter and consists of a computer, magnetic tape unit, line printer, singal processor, weapons location unit with displays, B-scope, and the power distribution assembly (see Figure E-5). The

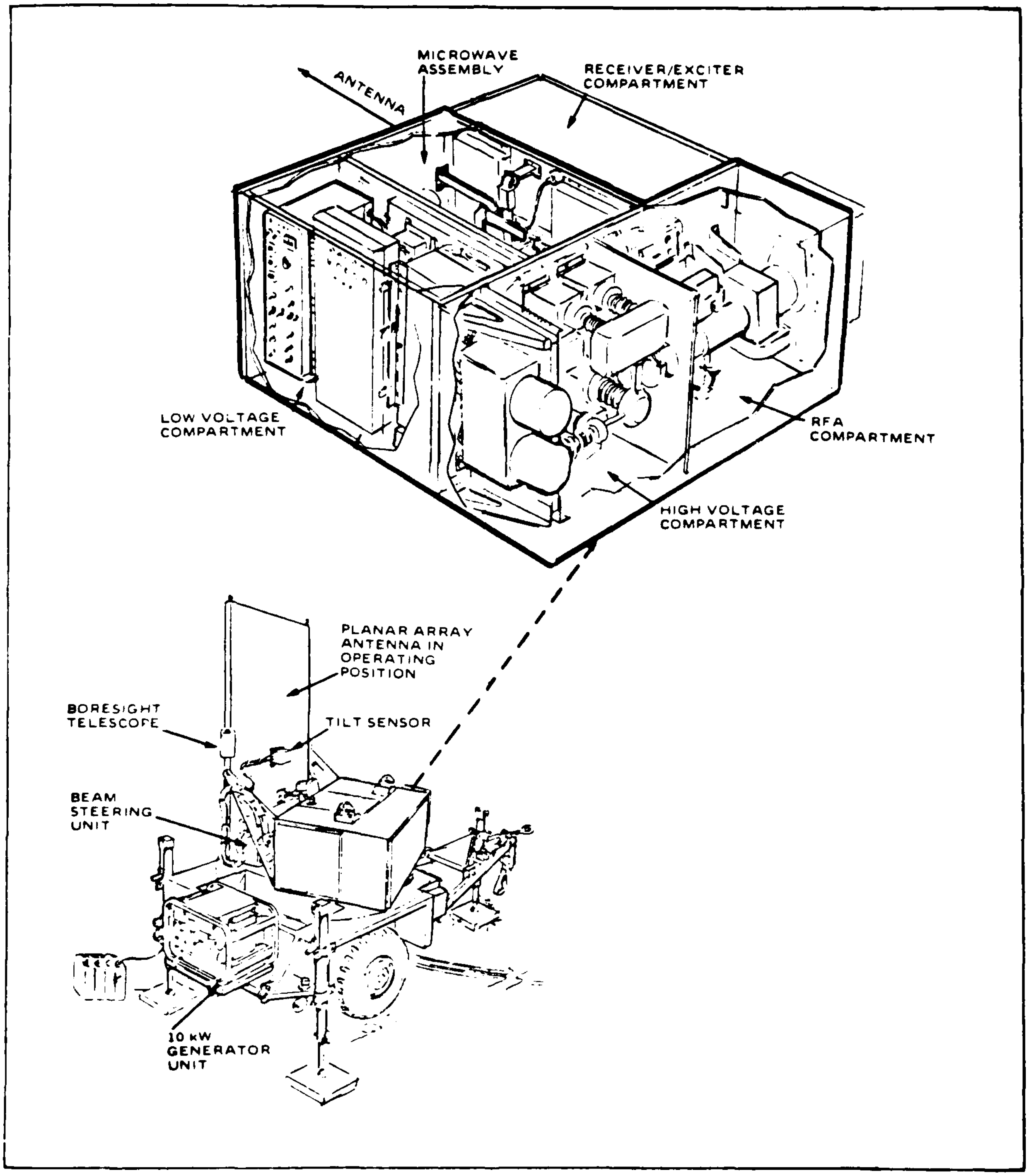


Figure E-4. Antenna-Transceiver Group

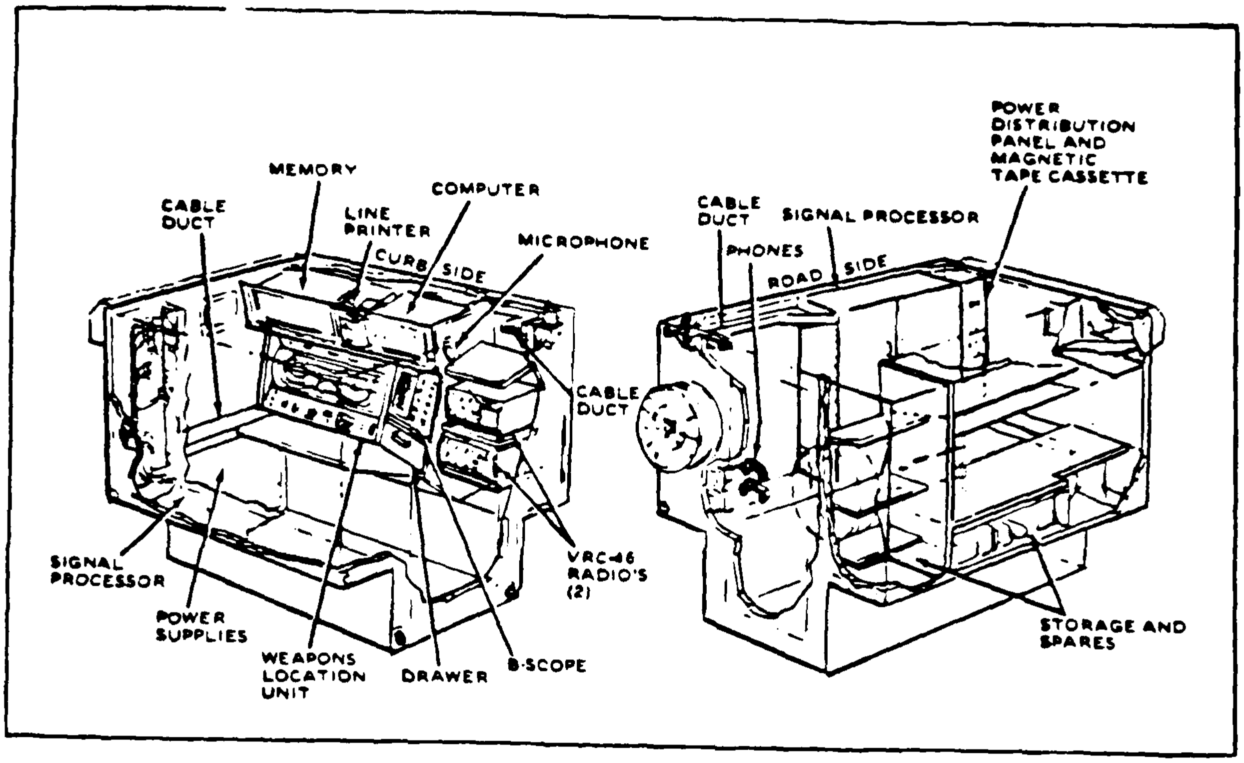


Figure E-5. AN/TPQ-36/37 Operations Control Group

hardware in the shelter is identical for both the AN/TPQ-36 and AN/TPQ-37. Figure E-6 shows the shelter equipment electrical interfaces. Figure E-7 shows the interchangeability of the common shelter.

The HMP-3637A Integral Computer is fully software compatible and I/O compatible with the AN/UYK-15. While functionally equivalent to the AN/UYK-15, the HMP-3637A incorporates new design features aimed at improving maintainability and environmental performance (e.g., microprogrammed Central Processor Unit (CPU), wide-temperature-range large-scale integrated (LSI) memory, firmware diagnostics, and physical integration of the computer and signal processor). The computer consists of a memory unit and a processor

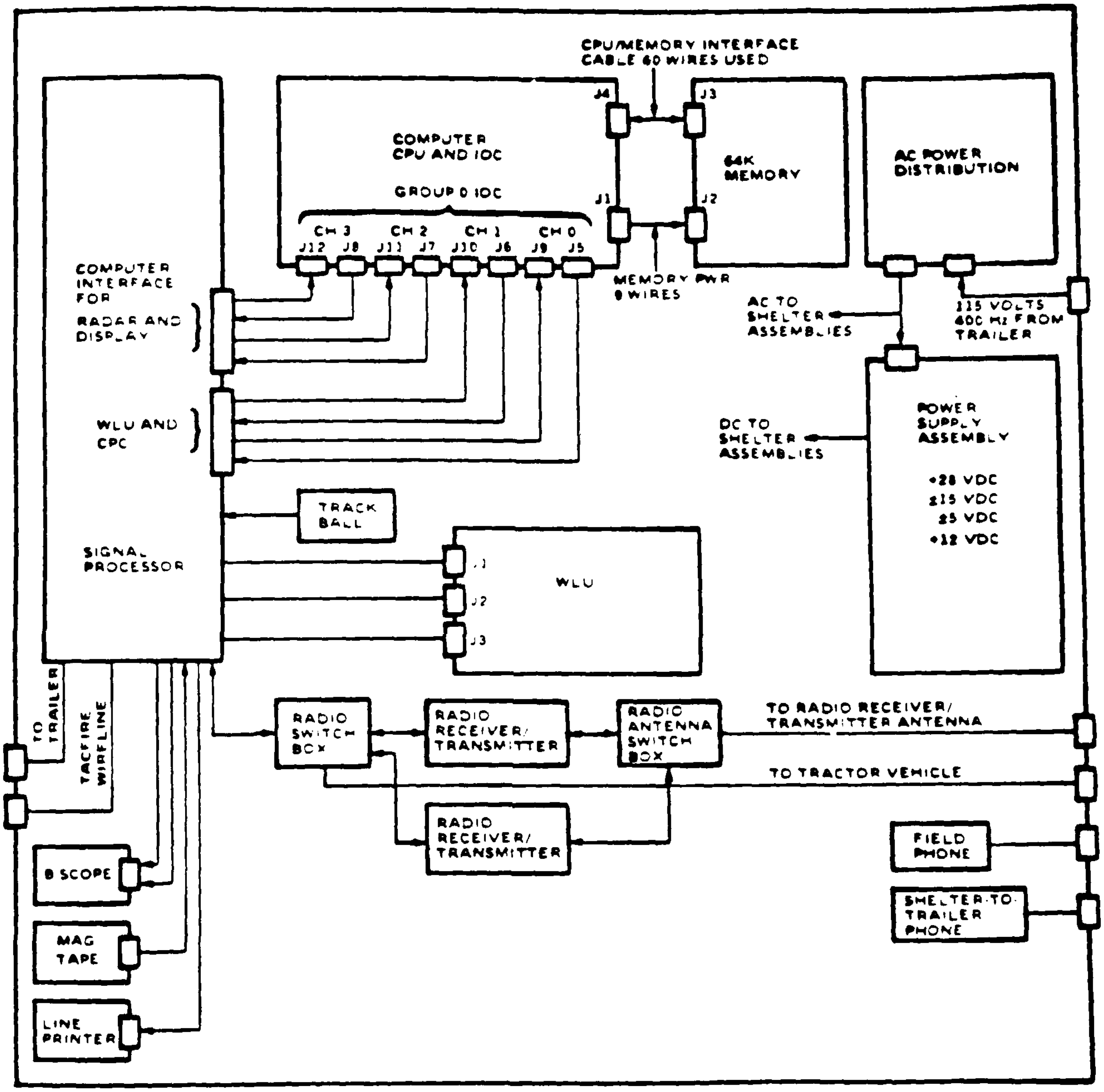


Figure E-6. Common Shelter Electrical Interfaces Diagram

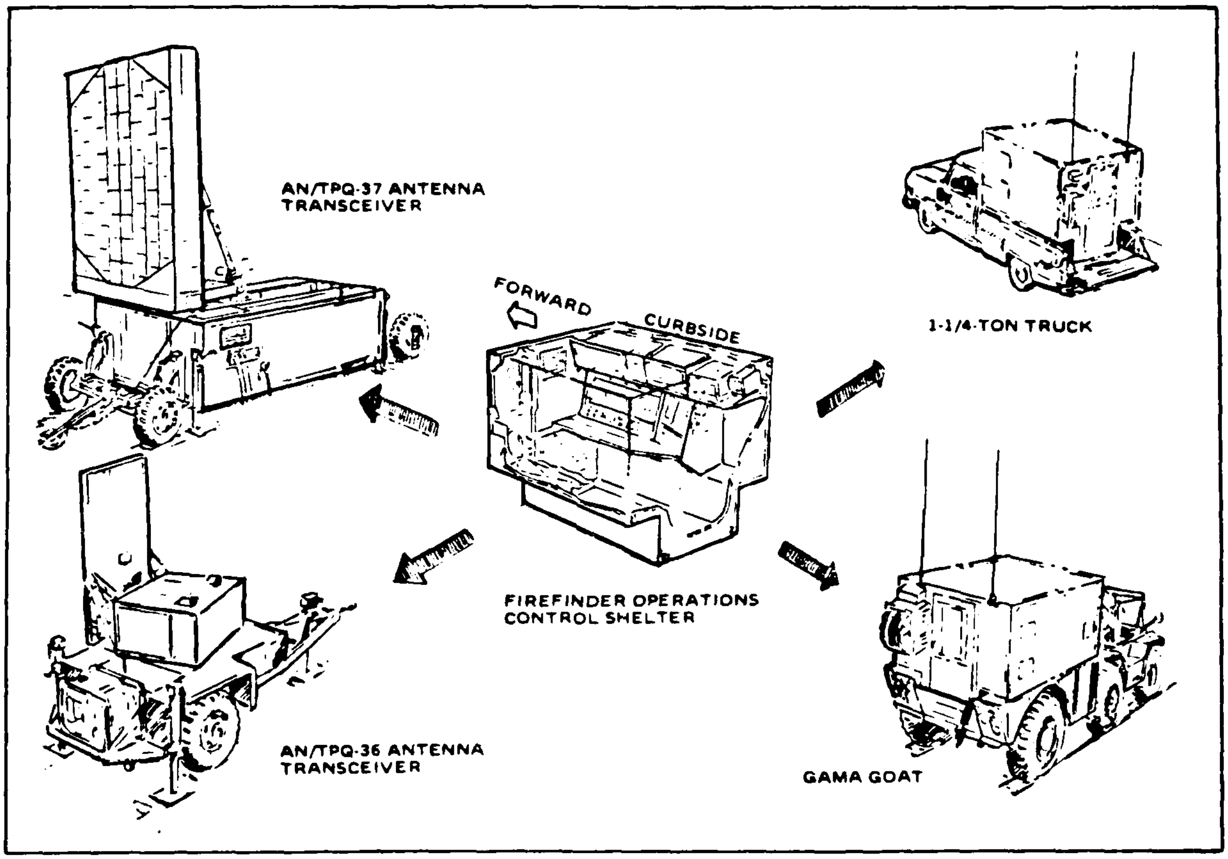


Figure E-7. Shelter Commonality

unit, both of which are mounted above the weapons location unit. The computer CPU features a microprogrammed design that makes extensive use of medium-scale integration (MSI) and LSI devices to reduce CPU complexity and component count without sacrificing performance. The architecture is of a general register design. All major CPU registers communicate by means of the A and B data buses. The HMP-3637A has 16- and 32-bit instructions; 8-, 16-, and 32-bit data word lengths; four program status word (PSW) selectable sets of 16 general registers; and a multilevel hardware priority interrupt structure. The computer normally executes program firmware but can also execute diagnostic firmware when it is in its diagnostic mode. This provides fast, accurate, GO/NO-GO fault diagnosis to the card level. The memory used in the HMP-3637A is constructed from extended-temperature-range LSI semiconductor components and parity checks are provided. The computer has 64K words of memory, but can be expanded, in 8K increments, up to 128K words. Firmware diagnostics can isolate memory failures to the chip level. Battery backup is provided to allow data retention for up to 30 minutes in the event of a primary power failure. The I/O section operates independently of the CPU once it is initiated by the CPU. The I/O consists of a microprogrammed controller plus individual channel logic for up to sixteen 16-bit, parallel I/O channels. By integrating the computer with the signal processors, significant hardware savings are achieved, since channel line drives, receivers, and cabling can be eliminated, thus minimizing circuitry on both sides of each interface.

The magnetic tape unit is the Raymond Model 6401 Tape Cartridge Unit (TCU), OK-(   )/TPQ-36, 37, which is a sealed-cartridge tape unit. One cartridge holds all operational, test, and diagnostic programs for the AN/TPQ-36/37 computer. The cartridge will hold 500K 16-bit words. The TCU is packaged in two modules: one contains all the tape motion and read/write electronics, and the other contains the tape transport assembly (consisting of the tape, the drive mechanism, the read/write head, and the beginning-of-tape (BOT) and end-of-tape (EOT) sensors). The electronic module contains its own power supply and does not require active cooling. The TCU is located just below the power distribution panel on the roadside of the common shelter.

The line printer, RO-524/TPQ, is mounted directly above the weapons location unit (WLU), providing hard-copy permanent records of relevant activities performed by the radar. These include operator actions, initialization, predicted points of weapon impact, time, target locations, meteorological data, and maintenance actions. The cartridge printer controller is a microprocessor-based design that consists of a microprocessor card, an I/O card, and two line driver/line receiver cards. The line printer is manufactured by Datametrics Corporation, and is an alphanumeric, high-speed, nonimpact, asynchronous, 33 characters per line, ASCII printer. The line printer has a predicted mean time between failures (MTBF) of 20,000 hours and provides easy maintenance with built-in self-test and fault isolation. Modular construction and plug-in circuit boards provide a mean time to repair (MTTR) of under 30 minutes.

The signal processor is contained in a single cabinet mounted behind the operator. The signal processor receives the intermediate frequency (IF) and coherent oscillator (COHO) signals from the radar and provides the necessary interface for the system computer. All the electronics within the shelter are under direct control of the system computer via four I/O channels. The computer program is loaded from the magnetic tape cassette and computer printouts are sent to the line printer over channel 0, the highest priority channel, via the cartridge printer controller. Two-way data transfer between the computer and WLU (e.g., weapon location data, operator commands, TACFIRE messages) is handled by channel 1. Both the cartridge printer controller and the WLU interfaces are implemented with a common Itel 8080 microprocessor design. Radar commands received by the processor from the computer and radar reports from the signal processor to the computer (targets, radar status, etc.) are communicated via channel 2. Channel 3 is used by the computer to output alphanumerics of the radar B-scope. Target detection is accomplished using two reference mean levels, an average of the leading and trailing means, plus a clutter-free mean derived from the clutter-free filters. Separate detection thresholds are specified by the computer for zero Doppler, edge, and clutter-free filters.

The weapons location unit provides the primary man/machine interface with the radar operational programs via keyboard entries to the computer and to all operator switch actions/displays. The operator at the WLU may enter data, select modes, and control radar operations. The WLU contains an automatic plotting board that displays target location on a standard Army map; a numeric display that shows the grid coordinates, height, and identification number of targets; and the operator controls. The plotting board is a rotatable drum assembly to which a universal transverse mercator (UTM) map is mounted for display of target locations. This plotting board automatically displays to the operator a single target of interest on a one-meter-square map. The map is rolled around a transparent drum and rotates with the drum. A bar containing 251 lights is inside the drum, parallel to the axis of rotation. A spot from one of the lights will shine through the transparent drum and indicates the position (within 300 meters) of the target. The map is supplemented by light-emitting diode numeric readouts of northerly and easterly position, and height of a weapon position or antenna grid azimuth, antenna mechanical tilt angle, and the time of day. The operator controls include a keyboard and switches, which permit the operator to control all functions of the FIREFINDER system from one location. The on-line fault detection reports system faults, including the computer-WLU interface, and the off-line isolation will locate the problem to one or at most two of the five microprocessor cards. On-line fault detection includes unexpected TACFIRE acknowledge received, no TACFIRE acknowledge received, WLU interface error, WLU switch/message code error, WLU switch queue full, WLU wraparound error, and on-line fault detected. Offline fault isolation includes microprocessor fault, map control digital fault, map control/drive analog fault, easting card fault, indicator driver fault, alpha logic row fault, and alpha logic column fault. Figure E-8 depicts the form of the WLU.

The B-scope unit converts processed radar video from the signal processor and alphanumeric data from the computer to a TV raster scan display on the B-scope cathode ray tube (CRT). Processed radar video is received by the B-scope video converter from the signal processor in transistor-transistor logic (TTL) voltage levels. Range and azimuth information are converted into a memory address and the intensity data are stored in the random access memory (RAM). Intensity data comprise a two-bit code, which is converted into four intensity levels on the CRT. Each memory word contains eight adjacent azimuths of the same range. This permits the relatively slow memory to be compatible with the horizontal output speed required for the TV raster scan. The display is refreshed at 30 Hz. The B-scope is a rectangular CRT presenting a range versus azimuth display on the left half of the screen, and a 16-line alphanumeric message on the right half of the screen. A cursor is provided to highlight targets or regions of interest. This cursor can be positioned anywhere in the CRT display area by the operator using the track ball. The B-scope is mounted at eye level and to the right of the WLU to provide convenient observation by the radar operator.

The power distribution assembly provides ac power monitoring and distribution for the shelter and handles the blower/temperature interlock and warning relay circuits for fault isolation to the individual shelter interlock or warning switch. Distribution of ac power in the shelter is accomplished using three circuit breakers. The distribution is based on shelter functional usage, which helps to reduce the number of circuit breakers and associated wiring. The

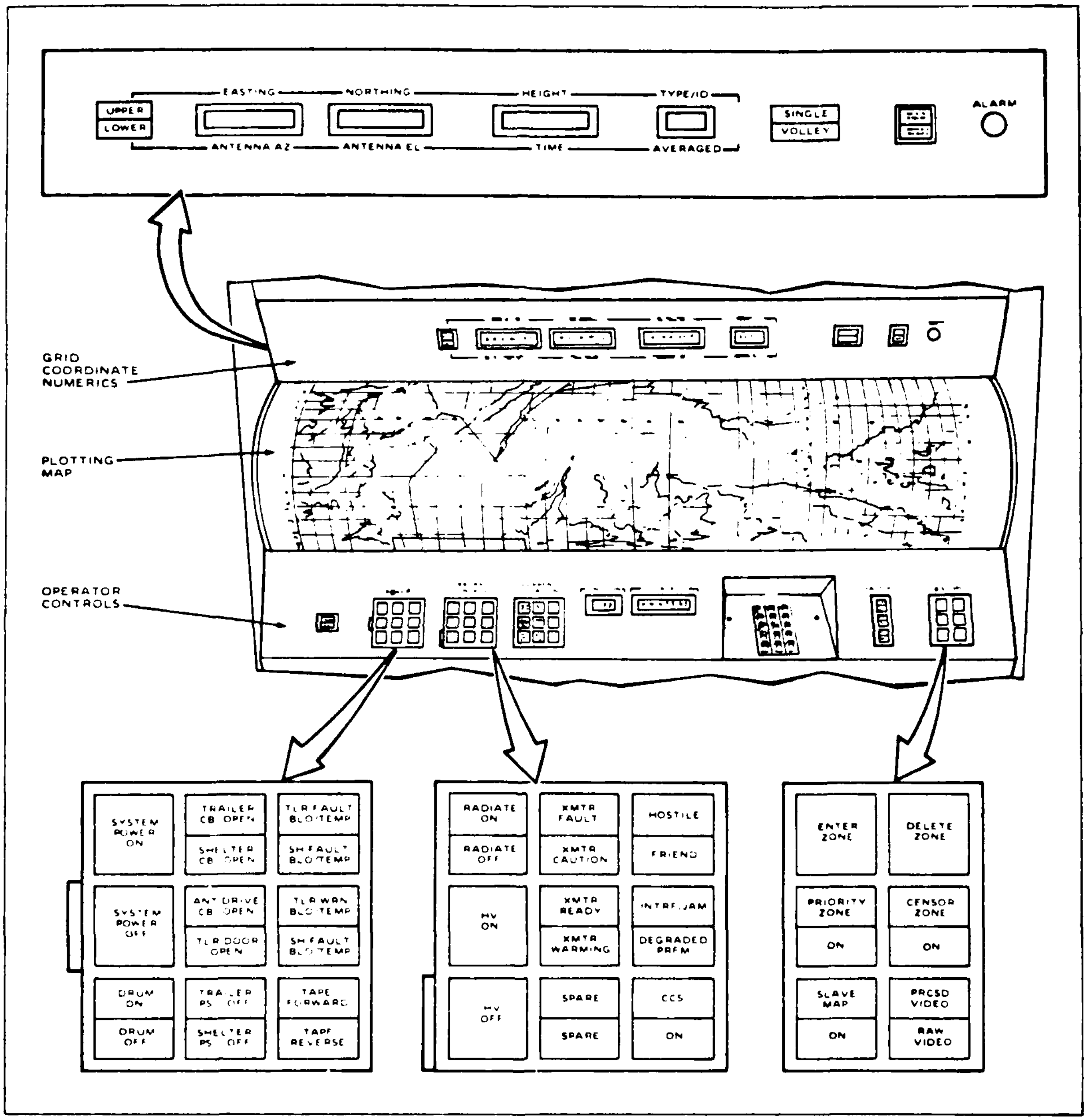


Figure E-8. Weapons Locating Unit

personnel heater and utility outlet are controlled by a toggle switch such that only one may be used at any given time. This is required because of prime power limitations during low-temperature operation. The shelter power distribution assembly front panel is behind the operator, adjacent to the signal processor in the forward roadside corner and contains the operator controls necessary to monitor and control the power and interlock/warning circuits within the shelter. A voltmeter and selector switch are provided to monitor line-to-line and line-to-neutral voltage on all three phases of the ac input power. Front panel mounted test points are provided across the blower/temperature interlock and temperature warning switches to allow these faults to be isolated to the individual switch.

The GFE communications equipment for the shelter includes two AN/VRC-46 radio sets containing two RT-524/VRC radio receiver-transmitters, and two TA-312/PT telephones. The radios are both of the same type for the purpose of redundancy and are manually operated for all functions except the transmission of TACFIRE messages, which is controlled by the signal processor.

The planned storage areas provide the space required to carry tools, spare parts, manuals, and other equipment as required. The main storage space is located under the WLU on the curb side of the shelter. Additional storage space is located beneath the shelves that hold the radios.

E.3 AN/TPQ-37 ARTILLERY LOCATING RADAR

The AN/TPQ-37 Artillery Locating Radar is a larger, longer range tactical radar than the AN/TPQ-36. It is capable of locating artillery shells and rockets of differing sizes and trajectories well beyond the forward edge of the battle area. The radar uses a combination of radar techniques and computer-controlled signal processing for detecting, verifying, and tracking projectiles; and extrapolates the tracking data points to the location from which the projectile was fired. Once the origin of a projectile has been identified and computer corrected for altitude, coordinates of the firing position are automatically transmitted to the Artillery Tactical Fire Direction System (TACFIRE).

The AN/TPQ-37 radar enables the Army to locate hostile artillery and rocket launchers at their normal firing ranges, including the location of weapons firing simultaneously from multiple positions. As a secondary function, the radar can be used to register and adjust friendly fire. Organic to division artillery and Field Artillery Target Acquisition Batteries (FATAB), the AN/TPQ-37 will be employed in the armor, infantry, and mechanized infantry divisions. The Artillery Locating Radar system consists of two vehicles with trailers (see Figure E-9). An M-813, 5-ton truck carries the generator/power distribution group and tows an XM-832 dolly set containing an antenna-transceiver group. An M-883 1-1/4-ton truck carries the operations control group, housed in an S-250 Common Operations Shelter, which consists of the data processing electronics and display and control equipment. Figure E-10 contains a functional block diagram of the AN/TPQ-37.

E.3.1 Generator/Power Distribution Group

The radar system generator/power distribution group, (   )/TPQ-37, consists of a power generator, a power distribution box, cable reels, power cables, and accessory equipment, all mounted on a single GFE pallet carried by an M-813 truck. Figure E-11 shows the generator/power distribution group equipment loaded on the M-813 vehicle in the transport configuration.

The AN/TPQ-37 system is designed to operate from a standard 60-kW, 120/208-V, three-phase, 400-Hz utility-class military generator equipped with remote sensing and paralleling capabilities. Voltage is sensed at the antenna trailer and carried back to the generator through the power distribution group for remote voltage sensing.

Power is carried from the generator to the distribution box and from the distribution box to the antenna trailer on MIL-C-3432 type cables utilizing five wire-grounded connectors per MIL-C-22992, class L. Cables between the

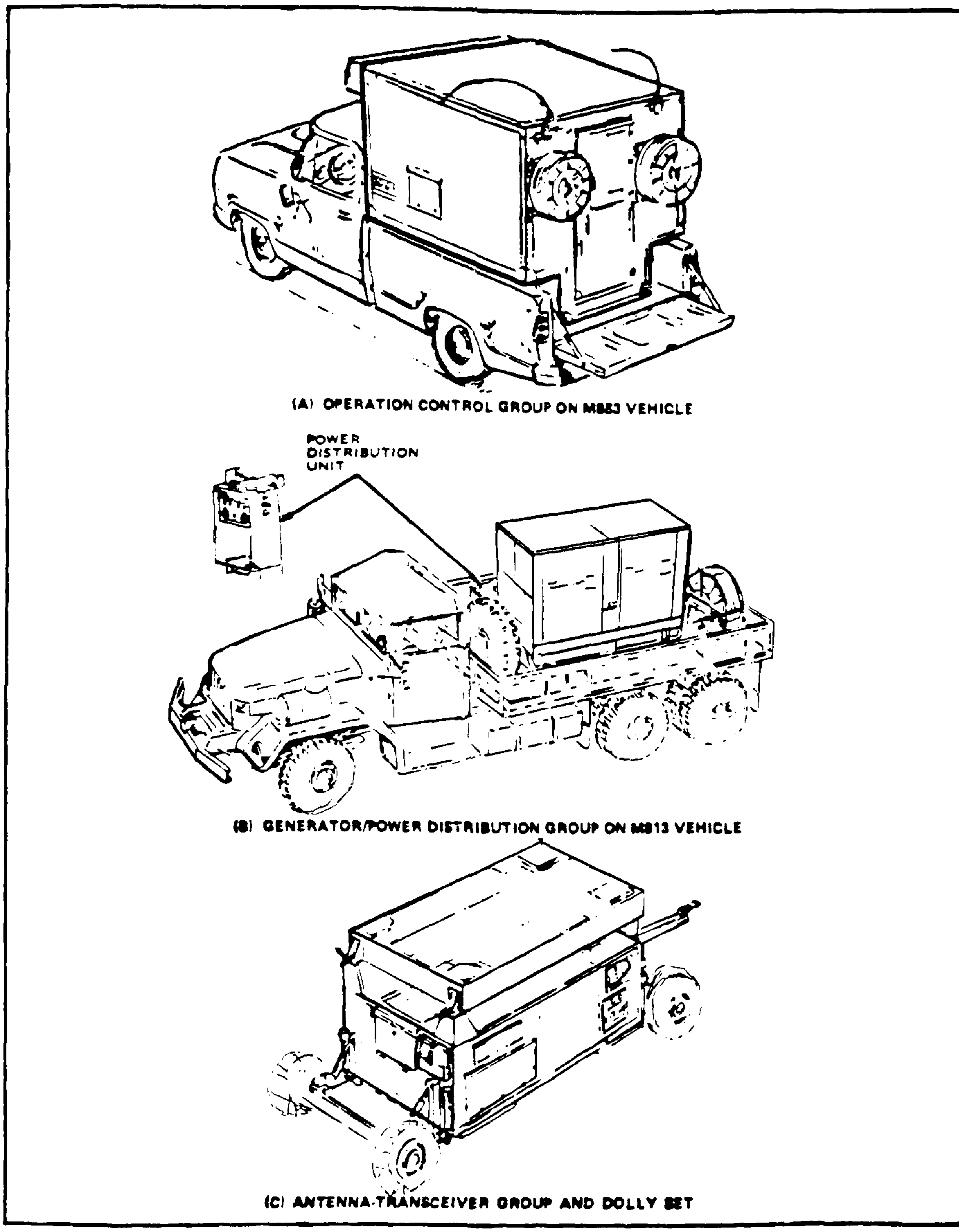


Figure E-9. AN/TPQ-37 Radar System Elements

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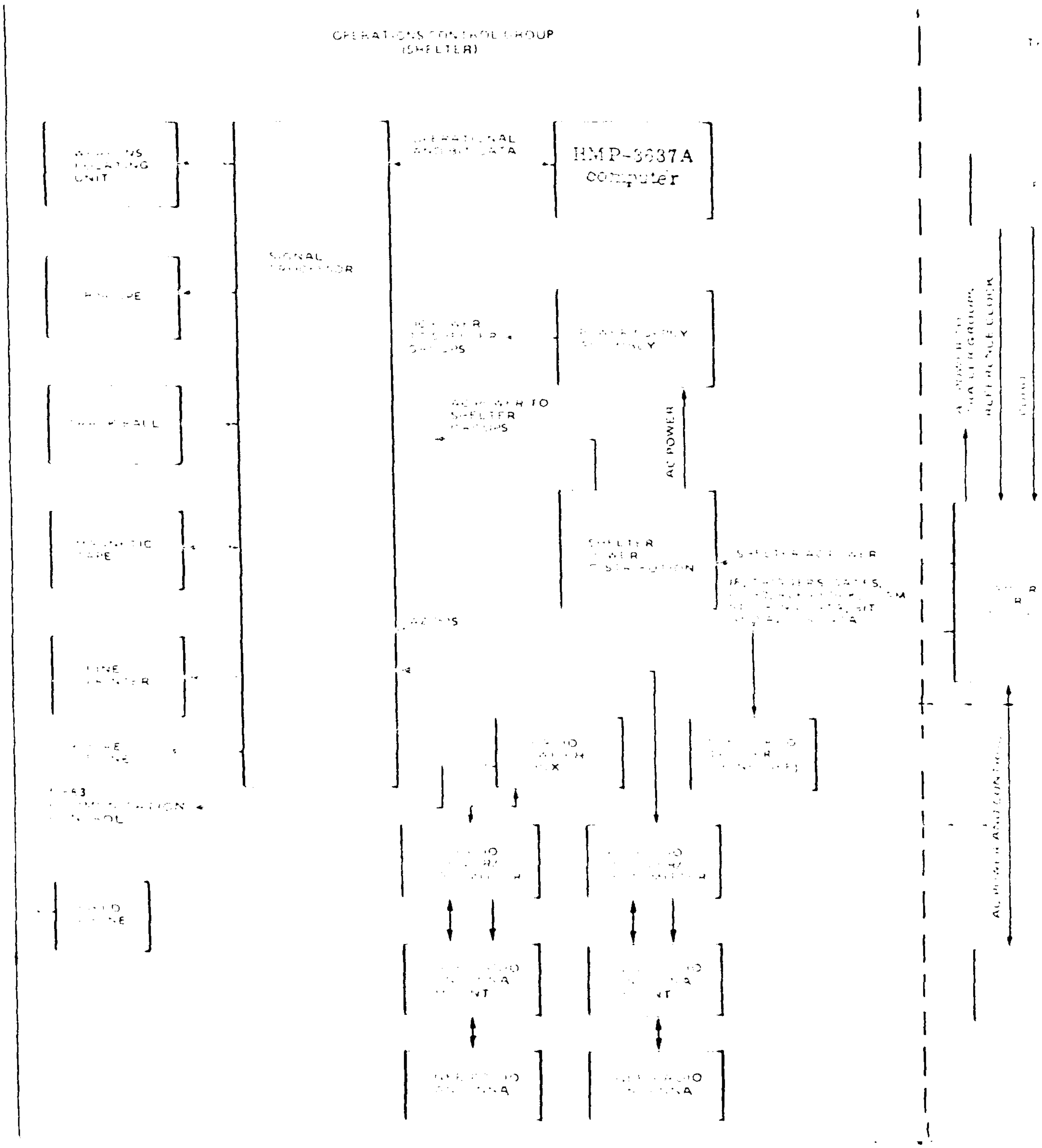
OPERATIONS CONTROL GROUP
(SHELTER)
HMP-3637A
computer
SIGNAL
UNIT
AC POWER
LINE

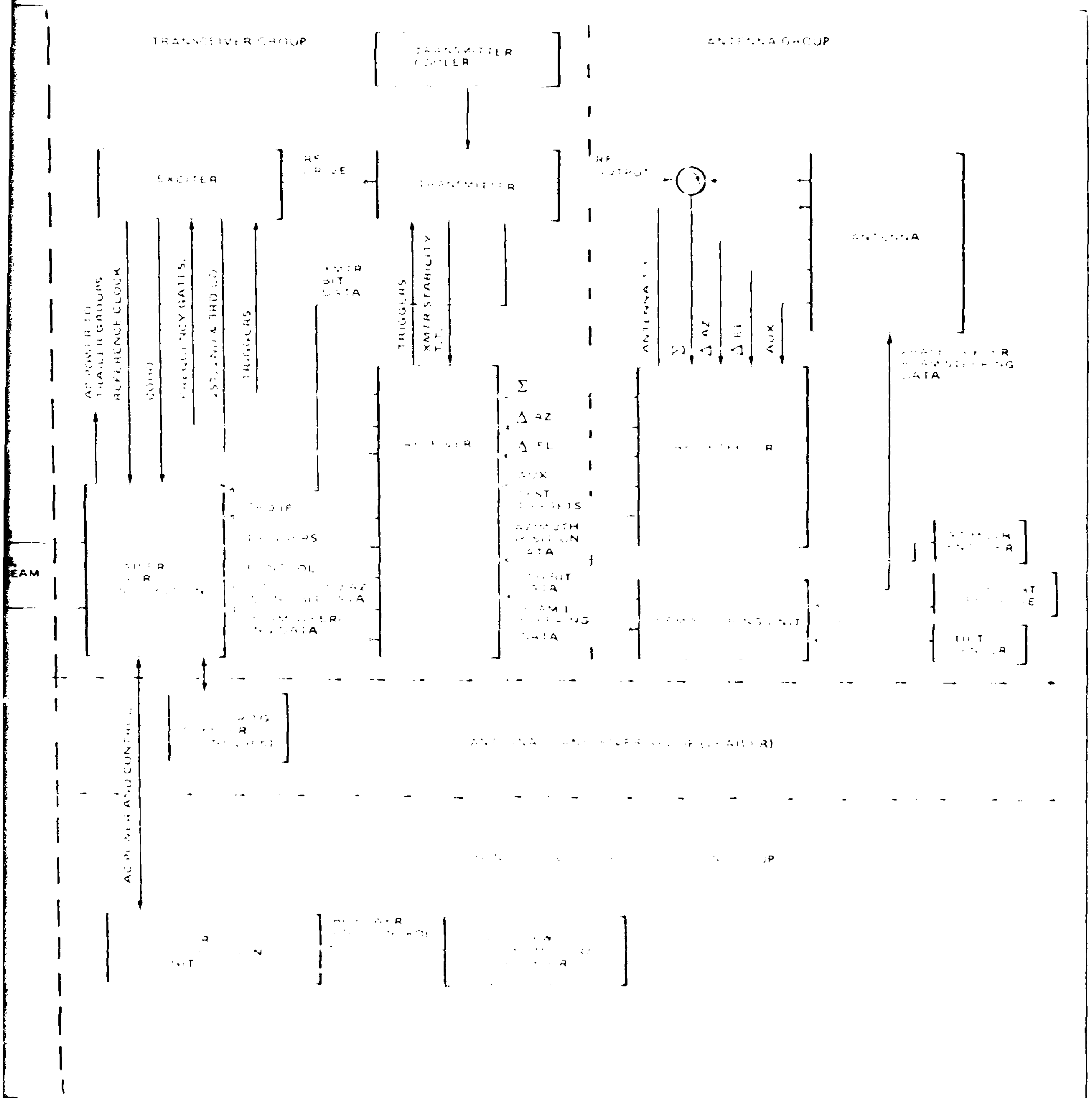

Figure E-10. AN/TPQ-37 F[illegible]al Block Diagram

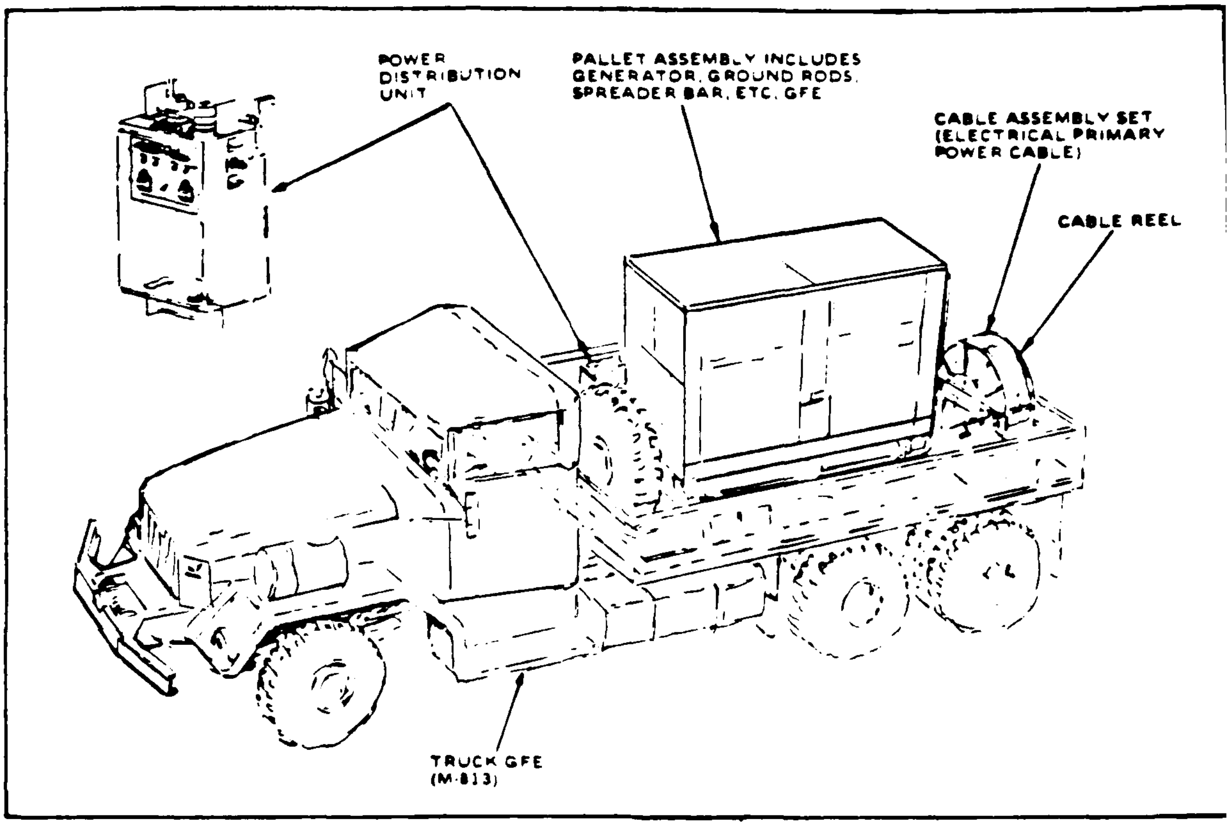

Figure E-11. Generator/Power Distribution Group

generator and the power distribution group are 8 meters long and those between the power distribution group and the antenna trailer are 32 meters long.

The power distribution unit is designed to provide the capability of parallel generator operating and switching of generators without the necessity of shutting down the system. The transfer of load from one generator to the other is accomplished by hooking a second generator to the power distribution group, bringing it on the line with the first generator in parallel, and then removing the first generator from the line. The actual paralleling of the generators is accomplished at the generator itself.

In addition to providing the paralleling and generator transfer functions, the power distribution box also provides over/under voltage-phase sequence protection and overload protection for the radar. Over/under voltage-phase sequence protection is provided by a solid-state relay, that will not allow the prime power contractor to pull in unless the voltage and phase sequence are correct. System overload protection is provided by a 150-A circuit breaker located inside the box with an external indicator to indicate when the circuit breaker is open. Additional indicators are provided to show that Generator No. 1 and Generator No. 2 are ON and that phase sequence is correct or incorrect for each generator. Lamp test switches are provided for all indicators.

E.3.2 Antenna-Transceiver Group

The radar system antenna-transceiver group, OY-( )/TPQ-37, consists of a GFE XM-832 dolly set carrying the antenna, transmitter, receiver/exciter, beam steering unit (BSU), RF detector, transmitter cooler, and trailer power distribution panel. Figure E-12 depicts the layout of the trailer. The ac power to the antenna-transceiver group from the generator/power distribution group enters the trailer at the curb side, front, where it is distributed to the units within the trailer and to the shelter through the circuit breakers of the trailer power distribution panel. The ac power to the transmitter is routed through the antenna rotary coupler compartment.

The operational program is stored in and implemented by the HMP-3637A computer, which is part of the operations control group. This computer sequences the radar by coordinating the operational frequency of the radar, interleaving the modes as the track load demands, scheduling the pulse repetition frequencies (PRF's) as required to optimize target location in the Doppler filters, and pointing the beam out of the antenna as necessary to perform the search, verification, and track functions of the radar.

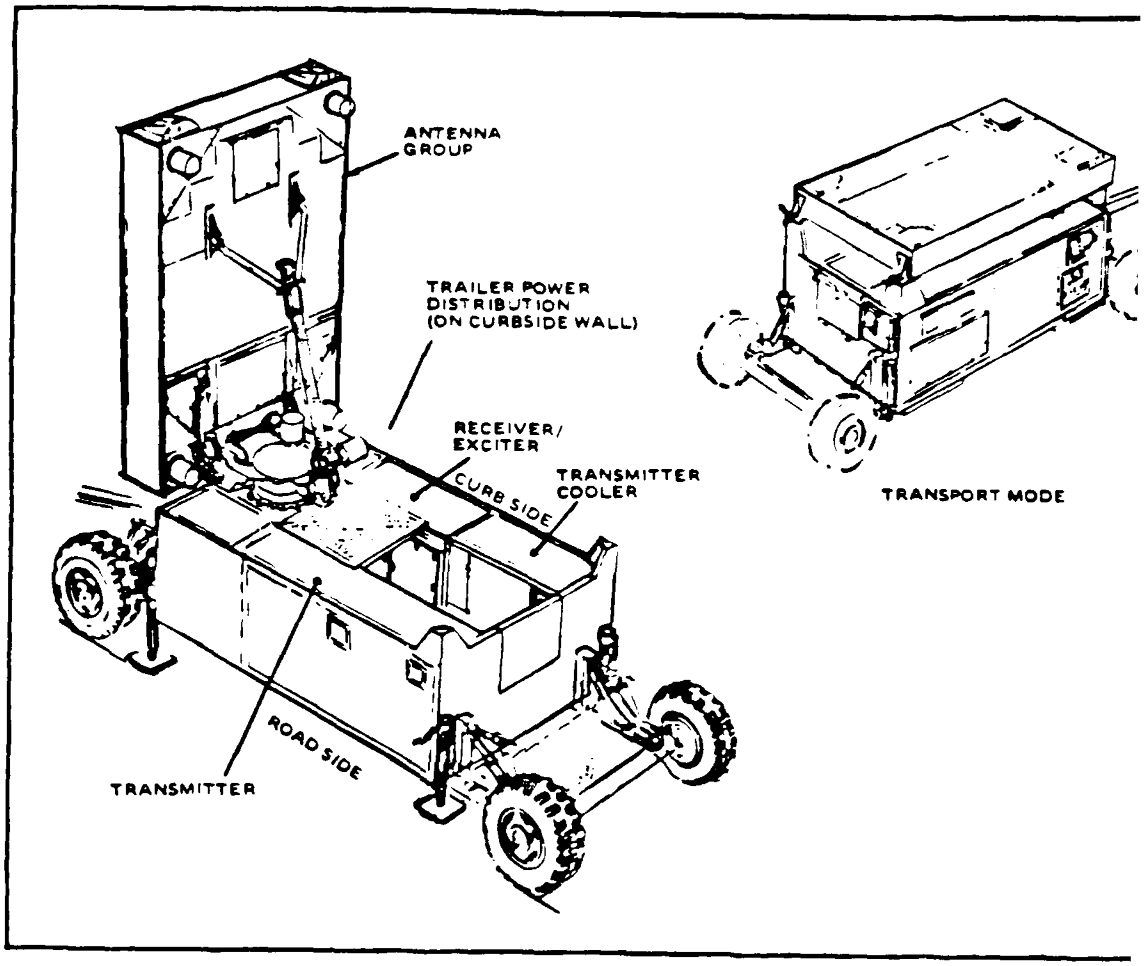

Figure E-12. Layout of Antenna-Transceiver Group

The AN/TPQ-37 antenna is a vertically polarized phased array providing 90-degree coverage. This phased array contains 359 subarray modules arrang in a rectangular pattern, with each module containing a diode phase shifter. Th antenna is a phase-steered subarray type, composed of dipoles grouped into phase-steerable subarrays. Phase steering is accomplished using phase-steering bits within each subarray.

The built-in-test (BIT) capability of the AN/TPQ-37 antenna is based on isolating any failures that can be corrected at the organizational maintenance level. This BIT requirement is accomplished by periodic, automatic injection of a test target into one of the 6:1 combiners. This checks the sum, azimuth difference, and elevation difference receive channels. More importantly, the test target checks the high RF power path from the duplexer to one of the high power outputs of the input waveguide power divider for signs of arcing. At least 90 percent of the failures that will significantly affect the antenna performance in the field are detected in this manner.

The exciter creates the RF drive for the transmitter (routed through the antenna rotary coupler compartment); the first, second, and third local oscillators (LO's) as well as the COHO for the receive function; and the reference trigger for the synchronizer in the signal processor. Frequency generation takes place upon the receipt of the computer-generated frequency command and the signal-processor-generated triggers. The transmitter amplifies the RF drive from the exciter through two stages of amplification and sends the RF output to the antenna rotary coupler through the waveguide switch and isolator. The first stage of amplification, a solid-state amplifier, is located behind the transmitter control unit panel, with the traveling-wave-tube located along the back of the transmitter. The RF power from the transmitter passes through the rotary coupler switch located under the antenna pedestal, through the duplexer attached to the back of the antenna, to power dividers that ultimately channel the RF power to all of the dipoles on the antenna face. The RF power from the dipoles is radiated into the atmosphere. Each of the phase shifters controls the phase setting of six dipoles, and are programmed under the command of the computer and decoded and implemented by the beam steering unit to focus and point the radiated beam. The reflected energy from each output pulse is gathered by the same focused beam that it was transmitted on with the energy combined into four separate channels: sum, azimuth difference, elevation difference, auxiliary.

The beam steering unit (BSU) converts the serial input beam comman to a format that allows the antenna beam to form after the phase shifters been set. The BSU is integrally located on the lower edge of the antenna access to the beam steering computer and phase-shifter driver cards fro radiating side of the antenna. The BSU acts as a summary point for the d from the tilt sensor, from the boresight telescope strobe, for the antenna erature sensor data, and for the status of the antenna group power suppli The power supplies are located along the lower edge of the antenna behind BSU.

The reflected energy contains mostly clutter returns with some targe mingled into the clutter. Separating the targets from the clutter while re the significant target parameters is accomplished in the receiver and the processor.

The RF detector equipment is integrally located within the back cavit the antenna structure. This equipment is separated into the four channe exiting the antenna: sum, azimuth difference, elevation difference, and a iary. The RF detector establishes the system noise level of the reflecte energy for each of the four channels in addition to protecting the four rec chains from high-incident RF. It also imposes a sensitivity time control function upon the energy of the sum and auxiliary. The receiver down-cc the reflected RF energy, positions the signal noise level at the third A/D using the receiver gain control function, reduces the gain of the receiver high-amplitude signals threaten to saturate the receiver chain while in tr mode using the automatic gain control function, and compresses the code turns to gain both location accuracy and an increased signal-to-noise rat The 10-MHz bandwidth of the wide-band track mode returns is reduced t using a tapped surface acoustic wave device, so that all of the data in the mode return information can be digitized in the 1-MHz A/D without losir data. The wide-band data are reassembled in the equivalent 10-MHz ba by the computer operational program.

The four channels from the RF detector are sent to the receiver, where the signal returns are down-converted and processed further for transmissio to the signal processor in the shelter. The receiver is located on the curb si of the trailer, approximately centered along the trailer length. The receiver also the location for the trailer control unit that interfaces the trigger and ga timing as well as considerable data between the trailer and the shelter.

The transmitter cooler supplies the coolant required by the transmitter a the antenna. The control for the cooler comes directly from the power distri tion unit. The coolant is routed to the antenna under the step at the rear of th trailer and through the transmitter to the pedestal and thus to the components in the antenna. The components that are liquid-cooled are the traveling-wave tube, the body regulator, the beam low-voltage power supply, the RF dumm load in the transmitter, and the duplexer and RF load in the antenna.

The A/D in the signal processor converts the analog in-phase and quadrat signals into digital words that are fed into the double-canceller moving target indicator (MTI) where the stable clutter is removed from the reflected signal returns. The Doppler filters determine the velocity of the remaining signals that will later be used to discriminate against unwanted targets. The mean le of the noise is established on a range cell by range cell basis so that a consta false alarm rate can be established. Target detection thresholds are set by tl computer, depending upon the operational mode. The clutter map is used to keep track of and to blank the stable clutter residue that is left over after MTI cancellation and to establish tracks on moving targets while verifying that the are targets of interest, thus removing the need to reacquire the same target o the next scan.

During normal operation, the computer commands a continuous search fence over a 90-degree sector just above the horizon until a detection is recei The detection causes a verification beam to be sent to where the detection was located. If a detection is found at the same range for both transmissions, the computer commands the beginning of the track mode while continuing mode over the rest of the search fence. Once track has been establis computer program applies cross section, velocity, and trajectory dis to establish that the target in track is an artillery shell or rocket. If fails one of the detection criteria, it is placed and tracked in an unknc file. Once the target has passed all of the detection criteria, the com calculates the trajectory path back down to an approximate weapon loc The height of the target and thus its location on the terrain map are c by a series of two or three iterations to give the final location either cally or manually. The manual height correction operation involves t ator reading the initial target location height on the terrain map with read out on the WLU height display. The operator enters the error b two heights. The computer recalculates and places the target at a ne This sequence continues until the location height and the readout heig within the accuracy of the map.

E.3.3 Operations Control Group

The AN/TPQ-37 operations control group is packaged in a standa Shelter and is identical to the hardware contained in the AN/TPQ-36 Shelter. See section E.2.2 for a description of the operations contro

E.4 FIREFINDER SOFTWARE

The computer programs for FIREFINDER contain all software el essary to support the systems and operational requirements. These programs perform the following general functions:

a. Radar real-time control
b. Communications with the operator
c. Communications with TACFIRE

d. Online fault monitoring and detection

e. Offline maintenance control and aid

The computer programs are divided into three computer program c items:

a. Operational/initialization programs

b. Diagnostic programs

c. Support programs

Each of these configuration items is an independent program area a identified for the purposes of organization and documentation. The follc sections describe the computer program components (modules) containe of the three computer program configuration items. An asterisk (*) ind computer program component (CPC) is included in the AN/TPQ-37 syst A plus sign (+) indicates the CPC is included in the AN/TPQ-36 system

E.4.1 Operational/Initialization Programs

The operational/initialization programs provide for the search, acq and tracking functions on all objects which are detected by the radar. T programs discriminate between projectile targets and other targets of n interest and perform trajectory fitting and backtracking on projectile da result of the backtracking is the presentation of a weapon location to the via the weapon location console and the small line printer.

The operational/initialization programs consist of the following CP(

a.	Executive	(E)
b.	Beam scheduling	(B)
c.	Initialization	(I)
d.	Search	(S)
e.	Verification	(V)
f.	Projectile tracking	(T)

g.	Projectile solution	(P)
h.	Display and switch actions	(D)
i.	Auto terrain following	(C)
j.	Online BITE	(K)
k.	Data recording	(R)
l.	TACFIRE processing	(F)
m.	Library	(L)
n.	Auto height correlation*	(H)

E.4.1.1 Executive

The executive program provides the nucleus for all prograr with the radar in real time. The structure of the executive pro with four cycles controlling the execution: the command cycle, cycle, the time cycle, and the data cycle.

The command cycle is concerned with the selection and for radar command which is output to the radar during the current command cycle is executed once per beam and call by the "rada (start-of-beam) receiver" routine. With priority over the othe this cycle causes suspension of the other three until it is compl

The report cycle is utilized for the processing of all data ir puter from the radar beam. The report cycle is called into exe pletion of the command cycle.

The time cycle provides for the periodic execution of time- such as peripheral device monitoring, switch action processing formatting. The time cycle is initiated by the report cycle in s approximate a time cycle execution every N (program adaptable milliseconds.

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The data cycle contains all those functions which execute on a time-available basis and do not have critical timing constraints, as is the case with the other three cycles. The data cycle is brought into execution upon the completion of system startup and continues to cycle on a time-available basis.

The four cycles are brought into execution on a priority basis, with the command cycle having the highest priority, followed by the report, time, and data cycles in descending order. The cycle managers are independent of the application routines through the use of routine bits which are assembled as a separate module. In this way, the same executive program is used for the operational/initialization programs and the BITE system.

The executive also includes: system restart-to-recover from certain hardware failures, system interrupt-radar, executive service decode, memory parity, real-time clock overflow, monitor clock, instruction fault, WLU, strip printer, power out of tolerance, memory resume, and so forth; and input/output initiator (WLU, strip printer).

E.4.1.2 Beam Scheduling

The beam scheduling program is called by the executive at the beginning of each radar dwell. It decides what type of beam is to be scheduled for the next dwell according to the following priority sequence:

a. Dummy beam
b. Track beam in a cluster of four
c. First beam of a new track
d. Verify beam
e. First beam of a track update
f. BITE beam
g. Search beam

Priority alternates between verify beams and the first beam of a track update, in that if the last beam scheduled was a verify, then a track update has higher priority than a verify. Also, if a dummy beam is requested during a track cluster, the dummy beam must either be scheduled between the second and third beams of the cluster or after the last beam of the cluster.

Projectile track beams are scheduled on a time frame basis. The time frame is a program adaptable constant and is nominally set for both the hostile and friendly fire modes. The time frame may expand under heavy load conditions to guarantee that all track beam requests are serviced before a new frame is started. This situation is unlikely however, since at most five tracks are updated during any one time frame.

In the hostile modes, the nominal update rate for a track is 30 measurements per second (one measurement per time frame) or 10 measurements per second (one measurement every third time frame). This nominal rate is determined by the projectile tracking function and is a function of the initial track range. A maximum of two tracks may be updated at the 30 times per second rate. Although the system has the capacity to carry a maximum of nine tracks at a time, the track store table has eleven entries, two for the 30 looks per second rate and the other nine for the 10 looks per second rate. This means that at least two entries must be inactive at any one time. Thus, during one time frame, the beam scheduling routine looks at the two top entries and then at a sequence of three of the remaining nine entries of the track store table. This procedure ensures that the first two entries are looked at once each time frame and each of the other nine entries is looked at every third frame.

After the track update sequence (2 + 3 = 5 tracks) is completed, a check is made to see whether or not the time has elapsed during the particular time frame. If it has not elapsed, the remainder of the time frame is generally spent scheduling search beams, although there is also the capability to schedule verify, BITE, and new track beams during this time. When more time has elapsed, some end of frame processing is performed, including the alpha smoothing calculations of the average duration and the average number of track beams of the last four time frames. The next frame is started using a new track update sequence with the same two top tracks but a different sequence of three bottom tracks. In the three friendly fire artillery modes, the nominal update rate for a track is 30 measurements per second.

The beamsteering routine also has the responsibility of detecting when surveillance processing is falling behind the signal processor. It attempts to correct this situation by inserting additional fill pulses for each beam and thus extending the dwell time. Up to seven additional fill pulses may be inserted, which extends the dwell time by approximately 50 percent. At present, all seven additional fill pulses are inserted for any beam scheduled while processing is behind. When processing has caught up to the signal processor, beamsteering stops inserting the additional fill pulses. Each time a beam with fill pulses is scheduled the beams with fill pulses counter are incremented.

Video integration is used to improve signal/noise of target data. To do this, the beam scheduler sends each search or verify command twice. Only the input from the second command which has been summed with the input from the first by the signal processor is processed by the program for target input. Track beams can be nonintegrated or integrated for 2 or 4 dwells depending on track range and quality.

A dummy beam is scheduled by the beam scheduling program whenever the antenna adjust flag is set or whenever requested by the executive. To schedule a dummy beam, the address of the 13 dummy beam command words in the beam command table is passed to the executive. Additional fill pulses are inserted, and the transmitter enable bit is turned off for all dummy beams.

E.4.1.3 Initialization

The initialization program provides the operator with the capability of initializing parameters to be used by the operational program. There are two methods by which the operator may initialize these parameters. First, all the values retained from the previous operating session may be used, or, as a second choice, new parameter values may be entered through the weapons location unit keyboard.

When the choice is made to input new values, the initialization function guides the operator via the WLU function code display strip printer and B-scope as to the sequence of the inputs. The initialization function formats the input data and computes additional data from the inputs as needed by the operational programs. Upon completion of the initialization function, each parameter is saved in a protected area of core (retained data area), and program control is transferred to the system loader part of the executive which loads and starts the operational programs.

The initialization program maintains the retained data base and defines that area of core used to preserve data that are of a semipermanent nature. This data base allows data to be passed to the other programs and allows data to be saved in the computer from one operating session to the next. This data base includes meteorological, WLU map initialization, hostile search control, site initialization, display, TACFIRE, stabilization, beam scheduling, tracking, and projectile solution data; search beam parameter, local ID number, location, and zone boundary definition, function code pulse repetition frequency (PRF), and terrain-following tables.

E.4.1.4 Search

The search program controls the firing of search beams and processing of the radar target data (the return data from the search beam).

The search beams are fired across the sector, left to right, just above the horizon. The area covered by each beam is slightly overlapped by the adjacent beam. The pattern formed by the series of search beams is called the "fence". One complete sweep across the sector is made up of two consecutive scans where each scan sends alternate beams along the fence. The beam firing order is sequential. The odd-numbered beams are fired on one scan, and then the even-numbered beams are fired on the subsequent scan. Each beam is therefore fired once on every two scans.

The hostile search sector can be varied by specifying the leftmost and rightmost beam positions. The friendly search sector is constant and centered about the predicted intersection with the trajectory. The PRF's of the transmitted search beams are varied, and, for each beam position, a sequence of three different PRF's is used. Each of the three PRF's used is selected on a slow-to-fast scale to have two adjacent PRF's that are unused.

The target report for the previous firing is saved for each beam. If the count is greater than four on two successive beam firings of the same beam, a message is written on the printer indicating the time, beam number, and minimum report count; detection data from the beam are ignored until the report count becomes less than five. If the target report is greater than the maximum limit on a single beam return, than all detections from that beam are ignored, and no message is output to the printer.

E.4.1.5 Verification

The verification program resolves targets in range and doppler velocity and performs preliminary discrimination. During this phase, verification beams are directed at newly detected targets, and the resultant target data are processed. The verification beams use various PRF's that are a result of logic derivation to maximize the probability of detection. The selected PRF is adjacent to the PRF that first detected the projectile in the search mode. New range targets which can definitely be classified as nonprojectiles can be dropped, and future detections will be blanked by the hardware clutter map. Projectile tracks will be set up on all other targets.

E.4.1.6 Projectile Tracking

Projectile tracking performs the processing required to collect radar data on all projectile tracks. This includes firing of dedicated track beams and processing of track beam data. The collected data are passed to the trajectory and extrapolation function for final processing.

The tracking beams are fired in groups of four consecutive beams to obtain each track measurement. The beam is shifted in frequency to get the elevation pair and in phase to get the azimuth pair; small phase shift corrections are added to keep the azimuth and elevation beam pairs orthogonal. For each track beam command, optimal PRF is selected, as well as range gate start and filter notch.

When a good track has been selected based on passing discrimination tests, the search and verify functions are discontinued, and only four-beam clusters are fired for this track until it terminates. The pattern of the beam cluster covers the area most likely to contain the projectile. The clusters are sent out at either the low (10/sec) or high (30/sec) data rates. The high data rate is used for the short range detections because of the high elevation rate.

Target report data from each four-beam cluster are processed to obtain accurate target coordinates. Range-splitting uses a weighted average of the split value obtained for each beam. Doppler range rate is also computed as a weighted average of the filter split values from each beam. Target azimuth and elevation are computed by adding the beamsplit delta corrections to the commanded beamsteering direction cosines. These are obtained from the frequency and phase using temperature corrected antenna dimension parameters and antenna calibration curves. Detection filter amplitude differences are used to compute the azimuth and elevation beamsplit delta angle.

Beamsplitting will be done only if both beams of a pair get hits (threshold crossings); if neither beam of a pair gets a hit, the predicted angle will be substituted; and, if only one beam of a pair gets a hit, a delta elevation or azimuth value will be substituted. These substituted target data may be used to update the track but would not be used in the projectile solution. A miss occurs when none of the four beams gets a hit; after a number of misses, the target is declared lost.

Track update is performed after all of the four-beam clusters have been processed. Separate sets of alpha-beta smoothing are computed for the X, Y, Z position and velocity, and for the range and doppler values and their derivatives.

Recording of all target data is done following processing of the inputs of each four-beam cluster. Recorded data will include range bin, detection and adjacent bin amplitudes, detection filter number, detection and adjacent filter amplitudes, mean level, and AGC for each beam. Other target data include azimuth and elevation for beamsteering, antenna azimuth encoder, and processed target range and doppler. Additional command data include frequency, phase, PRF, range gate start, and filter notch; track status data include derived velocities, hit/miss count, and smoothing indices.

Remote stationary test targets can be tracked and recorded using the same program configuration as for projectiles, with an added routine to accumulate sums to obtain measurement averages and standard deviation. This feature is used to evaluate system range-splitting, range bias, beamsteering, angular accuracy, signal-to-noise calibration, and antenna calibration.

E.4.1.7 Projectile Solution

This program takes the raw target plots and fits them into a trajectory model in order to obtain the best estimate of a seven-dimensional state vector at the closest possible point to the reference ground. Differential equations of motion are used on the state vector to determine the weapon position. The trajectory fitting process uses a Kalman filter algorithm to smooth the collected data into a path while, during the extrapolation process, a fourth order Runge Kutta integration technique is used to predict the projectile position to the ground reference during the process of backtracking.

The projectile solution program contains subroutines to correlate two weapon locations and average them, subroutines to interface with display routines, floating point library, earth curvature, fetch plot, predict state vector, polar to cartesian, and range computation.

E.4.1.8 Displays and Switch Actions

The displays and switch actions processing program processes switch action interrupts to the computer generated by momentary switches to the computer. The computer/operator interface is implemented through three pieces of equipment: the WLU, the B-scope, and the line printer. The WLU displays target locations on a terrain map and also provides the control interface. All operator switch actions which are relevant to the operational program software come into the computer from the WLU; in addition, the track ball position is sent through the WLU to the computer. The B-scope displays the radar sweep, video sensor position, and control zones. The line printer presents status and queuing messages to the operator and logs significant system events. This function also performs the processing required to light and extinguish the computer-controlled alarm, indicators, and switch legends. The display and switch action function performs the processing required to set up the data on the WLU panel, to process all operator inputs, and to update and maintain weapon locations and indicators on the WLU.

The autocensor feature is accomplished by examining each new track for proximity to existing weapon locations in the weapon location store; if a track appears to originate from a known weapon location, it is dropped. Autocensoring is performed in the hostile mode regardless of whether or not location averaging is enabled.

E.4.1.9 Auto Terrain Following

The automatic terrain following program consists of two routines: the automatic terrain following initialization (ATFIN) routine and the automatic terrain following operational (ATFOP) routine.

The ATFIN is run during system initialization after the automatic height correction (AHC) map entry. It is run whenever AHC loads a new digital map into core. ATFIN uses the digital map loaded into core to set up a 160 entry stable space elevation mask angle table.

The ATFOP is scheduled whenever the system start function code is received. It computes the radar space beam elevation mask table from the stable space elevation mask table set up by ATFIN using linear interpolation.

E.4.1.10 Online BITE

The online BITE program is used to periodically evaluate system operability and inform the operator of system faults. The online BITE uses three approaches to accomplish its task: (1) the periodic execution of signal processor tests, (2), continuous monitoring of the signal processor redundancy bit, parity bit, and wraparound word, and (3) the monitoring of device interfaces for status information and excessive time-out delays.

a. Periodic Tests — One of eleven signal processor tests is executed approximately every ten seconds. Each test consists of three identical test commands being sent to the processor. The response to the second command is evaluated. If it is in error, a fault is declared. These periodic tests are suspended whenever tracking or other processing loads are heavy. Periodic tests include:

   - Interface
   - MTI-noise
   - Doppler filter-noise
   - Threshold detection
   - Target detection - 1

- Target detection - 2
- Target detection - 3
- Target detection - 4
- Target detection - 5
- Beamsteering
- Receiver/exciter

b. Fault BIT Monitors — Every beam response from the signal processor is monitored for the occurrence of a parity, redundancy, or wraparound fault. Trailer status is monitored using the Trailer Status Report. In the case of parity or redundancy faults, error isolation is accomplished immediately by a printer message directing the operator to look for faulty cards using the circuit card edge-mounted fault LED's. For a wraparound word error, the operator is directed to run the signal processor offline diagnostic tests to isolate the error.

c. Interface Monitors — The initialization and operational executives constantly monitor the interfaces to the system peripheral devices (WLU, printer, cassette tape). The device status information and time-out delays are constantly checked for correctness. If a status word indicates a device fault, or an excessive time out is experienced, a fault is declared and the operator is directed to the appropriate diagnostic program. In addition, for the signal processor, the number of words transferred across the interface is monitored, to detect processor interface problems. The trailer status is monitored using status words and wraparound bits returned to the computer through the signal processor. Antenna elevation and azimuth, antenna temperatures, and beamsteering status are several of the items checked.

d. Operator Interface — When a fault is detected, a line printer message is printed giving the unit affected and instructing the operator how to begin fault isolation. This fault message is given high priority in order to force an immediate printout. Simultaneous with the printout, the SYSTEM FAULT light is lit and the fault alarm is sounded. Pressing the SYSTEM FAULT light once will stop the audible alarm, while a second pressing will reset the fault. Where necessary, the online BIT software may require two or more successive failures.

E.4.1.11 Data Recording

The data recording program performs the processing required to record system instrumentation data. These data include raw system data and selectable computer program parameters. The data recording function has the capability to extract data during the radar cycle, time cycle, or data cycle for recording onto a magnetic tape. The data selected for recording are accessible through the data reduction function with the same precision and time relationships as those which were obtained at the time of recording.

If conflicts arise in the competition for computer resources, then the data recording function has priority over the normal processing of the operational program. The data recording function is not normally used during system operations, but is extremely vital to the successful analysis and operation of the software support activity for problem solving.

The number of distinct groups of data is kept to a minimum in order to reduce the complexity in both recording and reduction functions. The operator has control over the beginning and ending of the recording process via manual inputs through the WLU keyboard.

The purpose of the data recording function is to record data which can be displayed and analyzed offline to verify the radar system operation. Two types of data are collected in order to fulfill the goal: (1) data generated or used by the radar system, such as, target reports, beam commands, switch actions, and BITE, (2) operational program-generated data and miscellaneous data.

E.4.1.12 TACFIRE Processing

The TACFIRE processing program assembles and transmits messages to TACFIRE and processes the acknowledge messages which are received from TACFIRE. There are nine message types involved in the FIREFINDER/TACFIRE interface. The following six message types are transmitted from FIREFINDER to TACFIRE:

a. Fire request with grid coordinates
b. Intelligence report
c. Subsequent adjust
d. Registration

e. Remote loop test

f. Acknowledge

Four message types are received by FIREFINDER from TACFIRE:

a. Message to observer

b. Free text and remote loop test

c. Acknowledge

d. Nonacknowledge

All messages except acknowledge and nonacknowledge consist of 48 characters (each character is represented by an eight-bit, odd-parity ASCII character with the parity bit being the most significant). The acknowledge and nonacknowledge messages are only 16 characters long. Each message contains a leader (first six characters); a body (characters 7-44 or 7-12); and a termination (characters 45-48 or 13-16), which is represented by at least four EOT characters.

The most recently received message from TACFIRE is saved in the computer's memory. The transmission repeat number of any incoming message (other than acknowledge and nonacknowledge) shall be checked; if it is nonzero, then the entire message except for the authentication code, transmission repeat number, and erroneous characters is checked for equality with the most recently received message in memory.

When a message is transmitted to TACFIRE, the time of initiation of transmission is saved. If an acknowledge or nonacknowledge response is not received from TACFIRE within the maximum wait time specified by the operator through function code input, then an error message (system) is printed and displayed to cue the operator to retransmit the message.

E.4.1.13 Library*

The library program consists of routines that support the operational program: linkage, character conversion, trigonometric functions, and common radar.

The linkage routine saves the contents of the currently active general-purpose registers for the calling routine in the corresponding temporary storage table. The contents of the registers are restored when the calling routine exits.

The character conversion routine converts an eight-character ASCII representation of an octal or decimal number to binary, a double precision binary number to an eight-character ASCII representation of its octal or decimal equivalent, a double precision binary number to a five-character BCD representation of its decimal equivalent, or a double precision binary number (time of day) to a six-character ASCII representation of hours, minutes, and seconds (HHMMSS).

The trigonometric functions routine computes the arcsine, arctangent, sine, and cosine of the input value as required.

The common radar routine consists of functions that are common to more than one group. This routine includes converting a beam number to the azimuth and the sine of that azimuth; computing the beam number from either the azimuth or the up cosine and east cosine; correcting the tilt sensor encoded value and the cross tilt sensor encoded value for the bias of the tilt sensor; stabilizing and destabilizing the north cosine, east cosine, and up cosine; and updating the stabilization conversion matrix with the most recent azimuth encoder and tilt sensor information during the time cycle.

E.4.1.14 Auto Height Correlation

The automatic height correlation (AHC) program utilizes a digital contour map stored in the computer. AHC requires three phases: cassette preparation, map loading during initialization, and AHC operation.

Digitized maps are presently recorded on 1/2" 9-track magnetic tapes which must be transferred to cassette for use by the FIREFINDER system. The cassette preparation routine takes the 9-track magnetic tape maps, selects grid size, changes to standard format, sorts the maps, and outputs to the cassette for system use.

During initialization, the map entry routine is called. It then reads the digital map from the cassette into core.

The operational part of AHC uses the terrain height data stored during initialization and the state vector obtained from projectile solution to find a terrain and trajectory height match. This height match (assumed to be a gun location or shell impact point) will be displayed by the operational program to the radar operator from subsequent processing. The AHC operational function performs target location, computes the terrain height for a given target location, and checks whether the target is inside the map.

E.4.2 Diagnostic Programs

This section describes the diagnostic programs which are used to verify that all equipment is operational. If an equipment fault is detected, these tests must isolate the fault to a replaceable module. These tests are either automatic or manual. These offline diagnostic programs are a set of programs designed to quickly and thoroughly evaluate system status, fault detect and isolate, and assist in system maintenance. Automatic tests can be automatically run by the computer without operator feedback or intervention. Each manual test requires some type of operator participation.

The diagnostic programs consist of the following computer program component groups:

a. Beam Steering Unit (B)
b. Trailer interface (F)
c. Test controller (H)
d. Status monitor (M)
e. Signal processor (P)
f. Receiver (Q)
g. Data Recording (R)
h. B-Scope (S)
i. Transmitter (T)
j. Weapons Locating Unit (W)
k. Antenna (Y)

E.4.2.1 Beam Steering Unit

The beam steering unit test performs fault detection on the beam steering hardware by means of built-in-test-equipment (BITE). Fault detection is in two categories; individual beam steering functional failures and a failed driver count. The test requirement is to automatically activate test circuitry via beam command, determine the proper reaction to a fault detection (failure or marginal), and to initiate a printout defining corrective action. The printout is initiated upon a failure detection, with failure printout having priority over marginal printouts.

E.4.2.2 Trailer Interface

The trailer interface test verifies the trailer control unit data interface to the command shelter. This data interface is checked by confirming that the report status words correspond directly to the system command configuration. The majority of the command configuration/status words verification shall be accomplished by the radar status monitoring routine (RSMR). It is the function of the RSMR to monitor the trailer and shelter status report words and provide the appropriate fault and/or warning messages. Incorporated into the RSMR are automatic lockouts for those status items where BIT functions are activated by the command configuration. All status items bypassed by the RSMR shall be checked by this test whenever their associated BIT commands are active. This test exercises the data interface function by sequencing through a selected set of operationally valid command configurations. This selected set of test commands shall be used to change the system mode and system timing to detect these faults which may be system configuration dependent. In addition, this test uses the various BIT functions to further verify the interface.

E.4.2.3 Test Controller

The test controller program is responsible for the control and execution of status tests and fault isolation tests. The controller is designed to provide almost all the functions required for the issuing of test commands, response checking, error detecting, fault isolating, and operator control of testing. Specific requirements for each test are defined through the use of data tables and unique test-dependent procedures (subroutines). The controller's functions are distributed among the executive's command, report, time, and data cycles.

The test controller consists of the following functions:

a. Subtest startup
b. Command processing
c. Report processing
d. Subtest evaluation
e. Time cycle processor

The subtest startup routine is executed when a signal processor has been requested, either by the operator or by the previously completed subtest. The functions of the startup include locating the subtest data base, preparing the system for testing, initializing the command and report routines, and initiating the subtest.

The command processing routine is executed once each command cycle of the executive program and is used to prepare the next signal processor command. This routine is executed once each command cycle, whether or not a test is underway. Dummy beam commands are issued when a test is not executing.

The report processing routine is executed once each report cycle and performs the report checking required by the subtest. The results of the report checking are stored in a data base for later use by the subtest evaluation routine. In addition, the report processing monitors the test's progress and sets a "subtest complete" indicator when all reports have been received and checked.

The subtest evaluation routine is executed in the executive data cycle upon completion of the necessary command and report processing. Its function is to determine if any reports for the current subtest failed and, in the case of fault isolation tests, perform the fault isolation. When a subsequent subtest is to be executed, this routine schedules the next subtest by setting a "test request" flag.

The time cycle processor routine executes in the executive time cycle. Its function is to control the weapon location unit status test and fault isolation tests. It performs scheduling and timing of the various subtest functions.

The test controller local library contains various subroutines of general application to the test controller. Examples include strip printer message formatting, signal processor command, and report and status table management.

The test controller data base includes data items and tables of a general nature, to be used by the test controller in performing two or more subtests. Examples include I/O buffers, test control and flag items, and the basic data base directory.

E.4.2.4 Status Monitor

The status monitor test monitors, during each dwell of the radar, the trailer status report and the shelter status report of the target report header to detect:

- Failures reported by BIT circuits (transmitter fault, LO fault, etc.)
- Intermittent failures of any status work or bit
- Data bus failures occuring after initial radar/computer synchronization
- Failure in antenna sensors due to short-term instabilities of long-term drifts
- Improper equipment configuration

Selected status items are checked once per dwell after initial radar/computer synchronization. Associated with each status item is a definition of its fault condition on a dwell sample. A detected status item fault on a dwell is used to define a status item failure.

E.4.2.5 Signal Processor

The signal processor is divided into functional units which are tested individually. Most of these tests are specified with a magnetic tape. Each test checks out a functional portion of the signal processor and is designed to operate as an independent module. The beams commanded and reports data checked are identical for the status test and the fault isolation test (FIT), the only difference being that the status test is simply a go/no-go test lacking the fault isolation logic of the FIT. Also, the interface buffer test is omitted from the status test. All faults detectable by the FIT are detectable by the status test and vice versa.

The signal processor BITE includes the following individual tests:

- Digital test pattern test
- MTI test
- Coefficient generator test
- Doppler filter test

- Signal processor phase, gain and bias correction test
- Signature card test
- Recombination test
- Pulsed interference detector test
- Receiver gain control test
- Input memory test
- Video integration and log
- Mean-level generator test
- Buffer
- Process cycle synchronizer test
- Threshold
- Target detect test
- Global mean
- Clutter map test
- A/D converter status and fault isolation test
- Synchronous detector
- WLU status test
- B-Scope manual status test
- Line driver/receiver test
- B-Scope interface test

E.4.2.6 Receiver

The receiver status test systematically evaluates the performance characteristics of operational functions within the receiver/exciter group. The status test consists of 18 modular tests. The overall status test organization endeavors to maximize the relative independence of the modular tests. Total independence of the modular tests is not possible, and there does exist an interdependence among many of the tests in which the order of sequencing is significant. The sequence dependency exists because basic operational receiver functions are tested prior to their use in other tests. The testing sequence is structured to minimize assumptions that each test must make about the status of other receiver and control functions.

The offline receiver/exciter test is a computer-aided test that systematically performs testing on the various functions within the receiver/exciter. The computer initiates commands which stimulate the BITE hardware. Combinations of GO/NO-GO signals and test target detections communicate the receiver/exciter status to the computer.

The receiver status tests are as follows:

- TR limiter
- Receiver gain compensation (RGC)
- Receiver noise level-RGC select
- Synchronous phase detectors
- Receiver gain test
- Track mode noise level
- Wide-band receiver gain test
- Surface acoustic wave slow down
- Narrow-band waveform coding
- Wide-band waveform coding
- Receiver AGC
- Receiver STC
- Incremental gain
- Exciter stability
- Auxiliary channel test
- Receiver "C" function
- Auxiliary incremental gain

E.4.2.7 Data Recording

The data recording function has the capability to extract data during the radar cycle, time cycle, or data cycle for recording onto magnetic tape. The data selected for recording are accessible through the data reduction programs with the same precision and time relationships as those which were present at the time of recording. The number of distinct groups of data is kept to a minimum to reduce complexity in both the data recording and data reduction functions. The operator has control of the beginning and ending of the recording process and CRIS buffer recording, via manual inputs through the WLU keyboard.

The purpose of the data recording function is to record data which can be displayed and analyzed offline to verify the radar system operation. Two types of data are collected in order to fulfill the goal: (1) Data generated or used by the radar system such as target reports, beam commands, and switch actions and BITE data, (2) operational program-generated data and miscellaneous data.

E.4.2.8 B-Scope

The B-scope tests consist of a prestored or computer-generated test pattern, which will be displayed on the B-scope sweep. This test provides the operator with fault recognition information. This test will cycle until it is stopped by the operator.

The B-scope test pattern is activated by the computer each radar dwell, via the command message from the computer to the command buffer.

E.4.2.9 Transmitter

The transmitter stability test is used to evaluate the system stability as a function of the signal processor doppler filter outputs of the transmitter amplified exciter RF drive signal. The transmitter sample signal is injected into the receiver sum channel at the input to the down converter. The processed filter outputs at the transmitter test target range cell are used to determine the transmitter stability. The stability is determined by a comparison of the target residue of each nonzero filter with the zero doppler filters containing the exciter test target. The difference between the average value of the zero doppler filter and a given nonzero filter is defined as the stability of that filter. The transmitter stability is measured on all frequencies. At each frequency, a single dwell value of the stability measurements, as well as a 16 dwell average stability, is checked. In order to get a better indicator of the system stability under operational conditions, the interpulse period is also varied with the frequency.

The transmitter power output test, by use of BITE hardware, monitors the transmitter power level in response to a test beam command sent by the test program. Fault detection is performed by program examination of the returned status report together with operator examination of the LED indicators. Other transmitter parameters, in addition to output power, are monitored during this test. If a fault is detected by the BITE, a NO-GO will be transmitted to the computer in the status report. The fault isolation process is performed by the maintenance man who examines the LED indicators on the transmitter fault processor panel and on the fault processor card. These LED's will indicate the proper corrective maintenance action.

E.4.2.10 Weapons Locating Unit

The purpose of the Weapons Locating Unit (WLU) status test is to evaluate the performance of the weapons location unit. The WLU test consists of an automatic test and an operator-initiated test.

The automatic test consists of two WLU wraparound tests, time-out processing and WLU internal fault processing. This test is active at all times during BIT programs. The SYSTEM FAULT indicator will be lit and the alarm sounded anytime a fault message is required. However, if a fault occurs during the WLU operator-initiated test, this occurs after the WLU test is terminated. The message or group of messages for each fault condition code shall be output only once, even though the fault occurs more than once. If the program is reloaded or restarted, the message(s) will be output again if a fault occurs.

The operator-initiated test is a WLU exercise which provides the operator with a method of visually detecting faults. This WLU exercise is capable of simultaneous operation with BIT routines run in the autotest mode. The intent is for the operator to conduct this test in parallel with the automatic test sequence. The operator initiates this exercise feature of the WLU test by pressing the LAMPS and ALARM/TEST switch on the WLU panel. The TEST indicator on the switch is turned on at test initiation and remains on until test termination, whereupon it will be turned off. The WLU test-started-message is printed when the test is initiated. The operator may terminate the test at any time by pressing the LAMP and ALARM/TEST switch a second time.

E.4.2.11 Antenna

The antenna test contains the antenna position and controls the status test short form and long form. These tests provide the control for the operator or maintenance man to move the antenna in azimuth or elevation. They dynamically verify the azimuth encoder performance and perform a confidence check on the tilt sensor.

The short form of the status test does a quick check of the antenna position sensors and controls. The following equipment is checked:

- Azimuth encoder
- Tilt sensor
- Antenna movement control
- Azimuth and elevation drive motors

The long form of the test performs all the checks performed by the short form. In addition, detailed computations of phase, bias, and amplitude of the wave generated by the tilt and cross-tilt sensors during motion in azimuth are made. A curve fit is made to determine how senusoidal the resulting wave is. Least squares errors are calculated and used as part of the criteria to determine the operational status of the tilt and cross-tilt sensors. The test takes approximately three minutes to complete.

E.4.3 Support Programs

The support programs consist of those programs that enable the operational software to be developed. The development process consists of generating the source program and creating the computer machine code in a manner that enhances loading and execution. The following paragraphs discuss the essential characteristics of support programs.

The librarian program is used to create and update the source program instruction files (source deck). Whether new software is being created or existing software is being expanded, modified, or corrected, the librarian produces the source tape, a cohesive file of the new source program logic.

The assembler program utilizes the source program data file(s) resulting from the librarian process and assembles it into a form (object tape) that can be executed by the computer after appropriate linking between program components. One of the other outputs of the assembler is source listing (program listing). These listings are a primary working document for programmers.

The SYSGEN program operates on the codes for each program module contained in the object tape, allocates memory addresses, and generates a linked operational software package. The SYSGEN program produces two 9-track magnetic tapes: the loadable tape, which is used for software testing, and the intermediate tape, which drives the cassette tape optimization (CTO) program.

The CTO program converts the output of SYSGEN, which is on a 9-track magnetic tape, to a form compatible for cassette tape. Not only does CTO convert from 9-track to cassette tape, but it reformats the data into larger physical tape records in order to optimize cassette capacity and access time. The net result of CTO processing is a loadable cassette tape for use in operational FIREFINDER Shelters.

The support programs consist of the following computer program components:

a.	System generation	(M)
b.	Loaders*	(J)
c.	Data reduction	(U)
d.	Utility (miscellaneous)+	(J)

E.4.3.1 System Generation

The system generation support program generates an AN/TPQ-37 system master tape from the object tape files produced by the assembler and resides on the UNIVAC system tape in a relocatable format. The program is organized into four functions which perform the following tasks:

a. Acceptance and processing of operator control data

b. Loading and writing the bootstrap record (absolute loader) to the intermediate tape device

c. Linking, loading, and writing the system records for each program to the intermediate tape device

d. Writing a cartridge tape unit (CTU) system master tape consisting of identical copies of the records that were written on the intermediate tape.

The program is executed under batch control, with control inputs from the card reader. Error messages are output to the line printer and/or the Uniscope-100. Operator entry at the Uniscope may be required after an error. Load maps for each program and the bootstrap record are output to the line printer. A CTU intermediate tape is output. The CTU master tape is generated on a cartridge tape unit.

E.4.3.2 Loaders*

The system absolute loader (SAL) reads the absolute program code from magnetic tape and loads it into the computer memory for execution. The tape format for the first record on both the cassette tape containing the system programs and the cassette tape containing the automatic height correction digital map is in the same standard format and includes a record check sum. The microprogram for the computer peripheral controller attempts to do a record check sum as part of the self-test feature and is independent of the cassette currently in the tape unit (program or AHC). In an effort to save tape (via deletion of all unnecessary interrecord gaps), each program written onto the cassette tape is written as one physical record.

E.4.3.3 Data Reduction

The data reduction support program provides a means of formatting and then displaying on a hard-copy device the contents of a data recording tape. These are two general types of formatted displays provided by the program and are referred to as:

a. Octal Dump Display — The contents of a data recording tape are formatted into six-digit octal words, eight words to a line, and displayed on the hard-copy device. The words are grouped by data block, and the data blocks are grouped by physical data records.

b. Controlled-Format Display — The contents of a data recording tape are extracted, formatted, and displayed on the hard-copy device according to instructions provided by the user. The user has many options for controlling the reduction process.

E.4.3.4 Utility (Miscellaneous)

The utility support program contains the following functions:

- WLU driver
- Auto start
- Cassette tape unit (CTU) bootstrap loader
- DATUM nine-track bootstrap loader
- Emergency core dump
- Inpsect and change
- Rewind CTU
- Flush core
- Program entry

APPENDIX F

SUPPORT AGREEMENTS

The following support agreements are included in this appendix:

- U.S. Army Communications Research and Development Command and Project Manager, FIREFINDER.

SUPPORT AGREEMENT	1. DOCUMENT IDENTIFIER ("X" one) ☐ NEW ☒ ANNUAL UPDATE ☐ REVISION ☐ DELETION	2. AGREEMENT DATE (Mo. & Yr) 1 February 1979

3. SUPPLYING ACTIVITY (Name & Complete Address)	3a. MAJOR CMD CODE	4. SUPPORT AGREEMENT NUMBER (DODAAD, Ordinal Date, Serial Number)	
US Army Communications Research & Development Command ATTN: DRDCO-TCS-BA-1 Fort Monmouth, NJ 07703	3b. SUBORDINATE COMMAND CODE X1	4a. PRESENT	4b. SUPERSEDED 215P63-78
5. TYPE OF AGREEMENT ("X" one) ☐ INTERSERVICE ☐ INTERDEPARTMENTAL ☐ OTHER		6. EFFECTIVE DATE (Mo. & Yr) 1 Oct 78	7. TERMINATION DATE (Mo. & Yr) 30 Sept 79

8. RECEIVING ACTIVITY (Name & Complete Address)	8a. DODAAD NUMBER	
Project Manager, FIREFINDER ATTN: DRCPM-FF-TM Fort Monmouth, New Jersey 07703	W15P63	
	8b. MAJOR CMD CODE	8c. SUBORDINATE CMD CODE

9. SUPPORT AGREEMENT RESOURCE SUMMARY

a. CATEGORY CODE OF SUPPORT SERVICE	SUPPLIER			RECEIVER		
	b. MAN YEARS		c. GROSS ADDITIONAL COST	d. MAN YEARS		e. VALUE OF RESOURCES PROVIDED BY THE TENANT
	MILITARY	CIVILIAN		MILITARY	CIVILIAN	
See Sheet 2						
TOTAL						
f. NET ADDITIONAL COSTS →				g. NET ADDITIONAL COSTS →		

10. SAVINGS ACCRUED AND/OR COSTS INCURRED TO FEDERAL GOVERNMENT		
SAVINGS	COSTS	REMARKS

11. FUNDING & REIMBURSEMENT ARRANGEMENT	12. COMPTROLLER SIGNATURE CONCURRENCE (Supplier)
FY-79 Internal Funds: $265K	13. COMPTROLLER SIGNATURE CONCURRENCE (Receiver)

14. TYPED NAME & POSITION OF LOCAL OFFICIAL FOR SUPPLIER	14a. SIGNATURE	14b. DATE
15. TYPED NAME & POSITION OF LOCAL OFFICIAL FOR RECEIVER	15a. SIGNATURE	15b. DATE
16. TYPED NAME & POSITION OF SUPPLIER APPROVING AUTHORITY JOHN F. PASSAFIUME, COL Director, CENTACS	16a. SIGNATURE	16b. DATE
17. TYPED NAME & POSITION OF RECEIVER APPROVING AUTHORITY THOMAS F. CAMERON, COL, OrdC Project Manager, FIREFINDER	17a. SIGNATURE Thomas L Cameron	17b. DATE 9 Feb 79

DD FORM 1144 PREVIOUS EDITIONS MAY BE USED UNTIL EXHAUSTED SHEET 1 OF 4 SHEETS

SUPPORT AGREEMENT RESOURCE SUMMARY

9a. SCOPE: This document defines the tasks CENTACS shall perform during FY 79 to support the FIREFINDER program.

(1) Develop a prototype Digital Cassette Tape Dubbing System. The purpose of this system is to transfer digitized terrain data from the DMA supplied tapes to Raymond cassettes. This task is composed of the following subtasks:

(a) Development of prototype hardware and software.

(b) Development of specifications for (a) above (both B5 and C5 levels).

(c) Drawings - Level 3 per DOD-D-1000A; The thrust of this requirement is to allow CENTACS developed hardware to be reproduced by a private contractor.

(d) Maintenance Manual (s) - May use the vendor's manual where applicable.

(e) Draft User's Manual - It is intended that non-professional personnel should be capable of operating this system. The user's manual should be written to reflect this intention.

(f) Develop a procedure for verifying that the digitized data from DMA accurately reflects the terrain data on the paper map of the area. This procedure will require a technically skilled operator.

(g) Develop a procedure for verifying that the data recorded on the Raymond cassette is accurate and is the information that was requested.

(h) Develop a specification that delineates what a user must specify when ordering a dubbed cassette.

(2) Develop a proposal to assemble a turn-key Cassette Tape Dubbing System to be installed at Tobyhanna Army Depot during FY 80. The proposal shall delineate system design, installation and training of three operator personnel.

(3) Development Software Support: This task is composed of the following subtasks:

(a) Software Physical Configuration Audit (PCA) for TPQ-37 Contract DAAB07-76-C-0893. Personnel shall be provided to review the Configuration Audit Plan, supervise the audit and review the Configuration Audit Minutes received. Six man-months of contractor support shall be provided by PM FIREFINDER to assist in performing the PCA.

(b) Contract Deliverables - The following software CDRLs will be tracked, reviewed and all comments furnished in writing to the Project Manager:

CONTRACT DAAB07-76-C-0893 (AN/TPQ-37)

CDRL NO.	ITEM	DATE DUE
A001R	B5 Computer Spec	Sep 77
A002R	C5 Computer Spec	Oct 77
A003R	Software for Computer Program/Systems	Oct 78
A004R	Software for Computer Program/Systems	Oct 78
G001	Computer Program Category I Test Rpts	Oct 78
G002	Computer Program Category I Test Plan/ Procedure	Oct 78

SOLICITATION DAAB07-78-R-1552 (AN/TPQ-37 EXTENDED LRIP)

CDRL NO.	ITEM	DATE DUE
2-6	Software Other than Bus Orient	See Seq. #2-10
2-10	Version Description Documentation (VDD)	15, 24 & 40 mos. ADAD
2-11	Congig. Index - Computer Progs	15, 24 & 40 mos. ADAD
2-12	Change Status Rpt - Comp Progs	Two months ADAD
5-1	User's Manual - Comp Prog	22 months ADAD
7-13	Copies of PTRs, PCRs and DCRs	90 days ADAD
B003	5B Spec Revisions	As needed
B004	C5 Spec Revisions	As needed
B005	ECPs - Comp Prog	As needed
B006	Spec Change Notices	As needed
14-4	Software Other than Bus Orient	15, 24 & 40 mos. ADAD
14-5	VDD - Comp Prog	15, 24 & 40 mos. ADAD
14-6	Change Status Rpt	As required
14-7	Config. Index - Comp Prog	15, 24 & 40 mos. ADAD
15-1	User's Manual (Comp Prog)	As needed
17-3	PTR, PCR & DCR	As needed
H003	B5 Spec Revisions	As needed
H004	C5 Spec Revisions	As needed
H005	ECPs (Comp Prog)	As needed
H006	Spec Change Notices (Comp Prog)	As needed

DAAB07-78-C-2409 (AN/TPQ-36)

CDRL NO.	ITEM	DATE DUE
2-11	SFTW-Other than Bus Orient	Sep 79
2-12	VDD - Comp Prog	Jan 80
2-13	CP Dev Spec (B5)	Aug 79
2-14	CP Spec (C5)	Aug 79
2-19	Change Status Rpt - Comp Prog	Oct 78
2-20	Configuration Index - Comp Prog	Jan 80
6-2	User's Manual - Comp Prog	May 80
8-17	Copies of PTR, PCR & DCR	Aug 79
8-18	Software Reliability	

(For CDRLs not deliverable in FY 79, indicate if preparation must begin in FY79).

Review of the aforementioned documents is contingent upon timely receipt of software related contract modifications from the PMO.

(4) Develop Product Improvement Proposals (PIPs) for the following items (Army Regulation (AR) 70-15 and DARCOM-P 70-5 dated Nov 77, "Product Improvement Management Information Report (PRIMIR)", will be used in developing these PIPs):

(a) Capability to read data from more than one map cassette.

(b) Variable height data interval spacing on one cassette.

(c) Memory expansion.

9b. Reports. A milestone chart and cost estimate shall be prepared for each task. The milestone chart shall show the critical events, when they are expected to occur, and their intra-task relationship. Milestone charts and cost estimates shall be delivered to the PMO by 28 Feb 79. A monthly report shall be submitted showing each task's progress and the money expended on it.

Periodic reports which are solely of a technical nature and involve funding impacts of 10K or less shall be routed through the Chief of the Systems Engineering Division, CENTACS, and the Chief of the Tech Management Division, PM FIREFINDER. All other reports or correspondence shall be routed through the Director, CENTACS, and the Project Manager, FIREFINDER. The report as of date will be the last working day of each month and will be furnished to the PMO by the 10th calendar day of the following month.

9c. Level of Effort: Four men full time.

9d. Points of Contact:

PM FIREFINDER - Mr. L. DeCosimo, X65424.

CENTACS - Mr. G. Yaeger, X52974.

APPENDIX G

SYSTEM PROBLEM REPORT

The following instructions pertain to the completion of the FIREFINDER System Problem Report (SPR):

1. Date of Failure. Enter the date and time the failure was discovered.

2. Unit/Site. Identify the unit or site reporting the problem.

3. Originator's Name/Organization/Phone No. Print the name of the individual preparing the SPR, his organization and code, and office phone number and extension.

4. Originator's Number. Enter the originator's number for tracking.

5. Title. Write a brief phrase or sentence describing the problem.

6. Serial Number. Furnish the serial numbers for the trailer, common shelter, and cassette tape of unit. When other equipment is used, specify what the serial number is for.

7. Running Time Meters at Failure. Enter the trailer, shelter, high-voltage, generator, and other (specify what) running time meter readings at the time of the failure.

8. Problem Duplicated. Check duplication successes or failures. Check N/A when attempts were not made.

9. Problem Description. Write a sentence defining the problem, then develop a word picture of events preceding and coincident with the trouble. Structure this word picture so that the systems engineer can recreate the situation. Cite the equipment being used, unusual configurations, and specific related data not required by other blocks. Also include function(s) being performed; mode of operation; elapsed time from program start until trouble occurred, in hours and quarter-hours; length of time of operational interruption; description of the extent of system degradation due to trouble; description of corrective actions. Indicate any link with other units (TACFIRE), computer stop data, and possible cause of trouble. Use continuation sheets and indicate "Page ______of ______Pages" if required.

10. FFSSC Action. This block is for FFSSC action. Circle correct action, Approved/Disapproved. Enter date logged, FFSSC SPR number, and referenced ECP number. Include comments (especially if disapproved), as required.

CLASSIFICATION

FIREFINDER

SYSTEM PROBLEM REPORT

1. DATE OF FAILURE
2. UNIT/SITE
3. ORIGINATOR'S NAME/ORGANIZATION/PHONE NO.
4. ORIGINATOR's NUMBER

5. TITLE

6. SERIAL NUMBERS

UNIT: ________ TRAILER: ________ SHELTER: ________ CASSETTE TAPE: ________ OTHERS: ________

7. RUNNING TIME METERS AT FAILURE

TRAILER: ________ SHELTER: ________ HIGH VOLTAGE: ________ GENERATOR: ________ OTHER: ________

8. PROBLEM DUPLICATED

	YES	NO	N/A
DURING RUN			
AFTER RESTART			
AFTER RELOAD			

9. PROBLEM DESCRIPTION

10. FFSSC ACTION – APPROVED/DISAPPROVED (CIRCLE ONE) DATE: ________ SPR NO: ________

ECP NO.: ________

COMMENTS:

CLASSIFICATION

APPENDIX H

STANDARD FORM 368

The following are the instructions to be followed when completing the Standard Form 368 for FIREFINDER system problems.

Section 1 is to be completed by originating point as the information is applicable and available. The screening point will ensure applicable items, not completed by the originating point, are completed to the maximum possible extent before a report is submitted to the action point.

1. From: Originating Point. The originating point will enter their address in item 1a and the name/duty phone/signature of an individual who can serve as a contact for questions regarding the report and/or to request an exhibit/sample in item 1b.

2. To: Screening Point. The originating point will enter in item 2a the name and address of the screening point (National Maintenance Point) to which the report is being submitted. The screening point will enter the name/duty phone/signature of the individual processing the report in item 2b. This item will be completed by civilian activities, when applicable.

3. Report Control Number. Each report will be identified with an Alpha/Numeric system as required by the participating component.

4. Date Deficiency Discovered. Enter the date the deficiency was discovered.

5. National Stock Number. Enter the NSN of the failed part.

6. Nomenclature. Enter the suspected parts nomenclature.

7. Manufacturer/Manufacturer's Code/Shipper. Enter N/A.

8. Manufacturer's Part Number. Enter manufacturer's part number, when available.

9. Serial/Lot/Batch Number. As applicable, enter the serial number, lot number, or batch number of the failed part.

10. Contract/Purchase Order/Document Number. Enter N/A.

11. Item is New or Repaired/Overhauled. Check the appropriate block to identify if the material is either new or repaired/overhauled.

12. Date Manufactured, Repaired, or Overhauled. Enter the date the part was last overhauled or repaired, if known.

13. Operating Time at Failure. Indicate the time the material had been in operation since this loading or restart when the deficiency was discovered by using hours and tens.

14. Government-Furnished Material. Indicate "Yes" or "No", as it applies.

15. Quantity. Enter N/A.

    a. Received. Enter N/A.

    b. Inspected. Enter N/A.

    c. Deficient. Enter N/A.

    d. In Stock. Enter N/A.

16. Deficient Item Works On/With.

    a. End Item. List major weapon system, item, or commodity that deficient item is to be used with or on (i.e., AN/TPQ-36 or AN/TPQ-37). Indicate the type/model/series and serial number for the end item, as applicable.

    b. Next Higher Assembly. Enter the unit and nomenclature of any units which are being interfaced.

17. Dollar Value. Enter N/A.

18. Estimated Correction Cost. Enter N/A.

19. Item Under Warranty. Check one of the blocks to indicate whether the deficient item is covered by a contractual warranty if known.

20. WUC/EIC. Enter appropriate code.

21. Action/Disposition. Check "OTHER" and in item 22 write "See Attached SPR."

22. Details. The SPR provides valuable information concerning the deficiency. Also list the supporting documents included with this report.

Section II is to be completed by screening point, action point, and support point as applicable.

23. To: Action Point. The National Maintenance Point will enter the FFSSC if applicable.

24. <u>To: Support Point</u>. The FFSSC may use item 24a to identify the name and address of a support point to which the report is being submitted. The support point may use item 24b to identify the name/duty phone/signature of the individual they assign to process the report. If more than one support point is involved, items 25 and 26 should be used.

25. <u>To: Support Point</u>. For use in addition to item 24 if needed.

26. <u>To: Support Point</u>. For use in addition to items 24 and 25 if needed.

Section III is to be completed by the action point and the screening point, as applicable. This section was designed as an internal record of investigation and for use as a reply document. Use for either purpose is optional to the participating component. The items are considered self-explanatory; however, generally they are used as follows:

27-28. For addressing a reply from the action point to the screening point and recording the name of the individual processing the report at each point.

29-34. For the action point to identify the item specification, if any, the method of report transmittal, the type of shipment or purchase involved, and other relevant data on the investigation conducted.

35-36. For the screening point to address the reply to the originator.

37. For the action point to identify to whom copies of the reply have been provided.

QUALITY DEFICIENCY REPORT
(Category II)

SECTION I

1a. From *(Originating point)*	2a. To *(Screening point)*
1b. Typed Name, Duty Phone and Signature	2b. Typed Name, Duty Phone and Signature

3. Report Control No.	4. Date Deficiency Discovered	5. National Stock No. (NSN)	6. Nomenclature
7. Manufacturer/Mfg. Code/Shipper	8. Mfg. Part No.	9. Serial/Lot/Batch No.	10. Contract/PO/Document No.

11. Item ☐ New ☐ Repaired/Overhauled	12. Date Manufactured/Repaired/Overhauled	13. Operating Time at Failure	14. Government Furnished Material ☐ Yes ☐ No

15. Quantity	a. Received	b. Inspected	c. Deficient	d. In Stock

16. Deficient Item Works On/With	a. End Item *(Aircraft, tank, ship, howitzer, etc.)*	(1) Type/Model/Series			(2) Serial No.
	b. Next Higher Assembly	(1) National Stock No. (NSN)	(2) Nomenclature	(3) Part No.	(4) Serial No./Lot No.

17. Dollar Value	18. Est. Correction Cost	19. Item Under Warranty ☐ Yes ☐ No ☐ Unknown	20. Work Unit Code/EIC *(Navy and Air Force only)*

21. Action/Disposition

☐ Holding Exhibit for ____ days ☐ Released for Investigation ☐ Returned to Stock/Disposed of ☐ Repaired ☐ Other *(Explain in Item 22)*

22. Details *(Describe, to best ability, what is wrong, how and why, circumstances prior to difficulty, description of difficulty, cause, action taken including disposition, recommendations. Identify with related item number. Include and list supporting documents. Continue on separate sheet if necessary.)*

SECTION II

23a. To *(Action Point)*	24a. To *(Support Point)* *(Use Items 25 and 26 if more than one)*
23b. Typed Name, Duty Phone and Signature	24b. Typed Name, Duty Phone and Signature
25a. To *(Support Point)*	26a. To *(Support Point)*
25b. Typed Name, Duty Phone and Signature	26b. Typed Name, Duty Phone and Signature

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STANDARD FORM 368, April 1974
General Services Administration (FPMR 101-26-7)

PRECEDING PAGE BLANK-NOT FILMED

Carbon paper is required — only face of form is chemical treated

SECTION III

27a. From *(Action point)*	28a. To *(Screening point)*
27b. Typed Name, Duty Phone and Signature	28b. Typed Name, Duty Phone and Signature

29. Specification No.	30. Originators Method of Notification ☐ SF 368 ☐ Msg *(Copy attached)* ☐ Phone Call/Visit

31. Type of Shipment/Purchase

Direct Delivery From Vendor: Other *(Specify)*

☐ Depot ☐ Stock Item ☐ Nonstock Item ☐ Federal Supply Schedule ☐

32. Findings and Recommendations of Investigation *(Explain in detail. Continue on a separate sheet of paper, if necessary.)*

33. Action Taken

34. Results of Depot Surveillance

35. From *(Screening point)*	36. To *(Originator)*

37. Distribution

STANDARD FORM 368 BACK
April 1974

APPENDIX I

INTERFACE CHANGE PROPOSAL (ICP)

The following instructions are provided for completing the ICP form.

Block 1. Priority. Indicate the applicable priority.

Block 2. ICP Cntl No. A separate block of numbers will be allocated to each interface user by the CORADCOM CMO. The numbering plan used will assure that the same number is not assigned to more than one ICP. The ICP numbers will then be sequentially assigned by the user and retained for all subsequent submittal of that change proposal.

Block 3. Class of Change. Enter the applicable change class.

Block 4. Data Prepared. Enter the date of submittal of the ICP using day/month/year format.

Block 5. Submitting Organization. Enter the name of the Government activity submitting the ICP and the name of the individual responsible for submitting the ICP.

Block 6. Authorizing Signature. An authorizing official of the organization entered in block 5 shall affix his signature in this block. This indicates the ICP has the official sanction of the submitting organization.

Block 7. Title of ICP. Enter a brief descriptive title indicating the purpose of the ICP.

Block 8. Description of Change. Describe the nature of the change in sufficient detail so that it may be clearly understood and evaluated. If the change cannot be described completely in words, supporting data shall be furnished.

Block 9. Need for Change. Enter a comprehensive discussion of either the problem the ICP intends to correct or the new capability the ICP intends to provide. The nature of the defect, failure, incident, malfunction, and so forth, substantiating the need for the change shall be described in detail. Full utilization should be made of available data.

Block 10. Effect on Interfaces with Other Systems/Users. If there are known effects on an interface with other users, describe such effect in this block. If sufficient space is not available to fully describe the effects, submit an enclosure and reference that enclosure in this block. If it is thought there may be an effect, but it is presently unknown, enter the following: "effect unknown."

Block 11. Estimated Cost/Savings. Enter the total estimated cost/saving impact on the contract for the applicable item. If a value engineering (VE) change proposal is involved, reference an enclosure showing estimated cost/saving analysis, including the impact on integrated logistical support (ILS) insofar as can be determined, and the additional information required by the VE clause. If both production and retrofit are involved, show a breakdown of both production and retrofit cost/savings.

Block 12. FAICWG. To be completed by the FAICWG Chairman.

Block 13. FAICCB. To be completed by the FAICCB Chairman.

INTERFACE CHANGE PROPOSAL (ICP)

1. PRIORITY ☐ EMERGENCY ☐ URGENT ☐ ROUTINE	2. ICP CNTL NO	3. CLASS OF CHANGE I ☐ II ☐	4. DATE PREPARED DY MO YR / /
5. SUBMITTING ORGANIZATION		6. AUTHORIZED SIGNATURE	
7. TITLE OF ICP			
8. DESCRIPTION OF CHANGE			
9. NEED FOR CHANGE			
10. EFFECT ON INTERFACES WITH OTHER SYSTEMS/USERS			
11. ESTIMATED COST/SAVINGS			
12. ICWG ☐ CONCUR ☐ NONCONCUR	DATE DY MO YR / /	SIGNATURE	
13. ICCB ☐ APPROVAL ☐ DISAPPROVAL	DATE DY MO YR / /	SIGNATURE	

DRDCO-CMO (TEST)

APPENDIX J

PRODUCT IMPROVEMENT PROPOSAL

The following are the instructions to be followed when completing the Department of the Army Form 3701-R (see pages J-5/6 and J-7/8) for product improvements to the FIREFINDER radar systems.

A. THE HEADING

1. OMA MAJ GROUP. Enter "E" for Electronic and Communication Equipment.

2. PA ACTIVITY. Enter "OPA II" for Other Procurement, Army: Activity II — Communications and Electronics Equipment.

3. RDTE PROJ NO. Enter the RDTE project number. Use a 15-digit number (the 12-digit project number and the 3-digit task number per the RDTE Project Listing).

4. SYSTEM/END ITEM. Enter AN/TPQ-36 or AN/TPQ-37 (as appropriate) FIRE FINDER.

5. REPORT PER. Enter the quarter and fiscal year of this report (e.g., fourth quarter 1982 would be 4Q82).

6. JUSTIFICATION CODE. Enter the one code that best describes the main justification or purpose of the PIP. Use only the number listed below in the "Code" column. The codes are as follows:

Code	Justification and Definition
1	Safety — Removes a hazard to people
2	New or improved operational capability — Increases a weapon system's performance envelope, increases resistance to countermeasures, or decreases combat vulnerability.
3P	Cost reduction (production) — Reduces the cost of production.
3S	Cost reduction (operations and support) — Reduces operation or support costs.
4	Reliability, availability, maintainability — Increases the RAM or dependability of the item.
5	Deficiency correction — Corrects a flaw that causes excessive malfunctions; creates a hazard to equipment, buildings, real estate, animals, etc.; or has led or could lead to security compromise.

Code	Justification and Definition
6	Rationalization, standardization, interoperability, compatibility, simplification — Increases system or component compatibility; improves the standardization or interoperability of parts; simplifies equipment operation.
7	Legislative compliance — Complies with laws and regulations issued by DOD or higher authorities.
8	Energy Conservation — Promotes savings of energy.

7. SSN/ZIN of SYS/END ITEM TO BE MOD. Enter the six-digit standard study number (SSN) and the six-digit line item number (LIN) of the system or major item to be changed.

8. POP NAME OF PIP. Enter a short title for the purpose of the PIP (e.g., "Solid State Regulator," "Hydropneumatic Suspension," "Deep Water Fording," "Smoke Reduction," etc.).

9. PIP IS: NEW START, etc. Mark the block preceding the term that describes the status of the PIP.

10. MAJ COMPONENT. If the PIP is to be applied to a major component of a system or major item that has a different LIN from the one discussed in (7) above, enter the name of the major component.

11. SSN. Enter the six-digit SSN of the major component discussed in (10) above.

12. LIN. Enter the six-digit LIN of the major component discussed in (10) above.

13. PIP NUMBER. Enter the nine-digit number that identifies the PI (e.g., 1-80-03-1004). The PIP number, once assigned, never changes. It is formed as follows:

    (a) The first digit (e.g., 1-80-03-1004) stands for the materiel developer.

    1 — US Army Materiel Development and Readiness Command

    2 — Chief of Engineers

    3 — US Army Communications Command

    4 — The Surgeon General

    (b) The second and third digits are separated from the first by a hyphen (e.g., 1-80-03-1004). These two digits stand for the fiscal year in which the PIP is first submitted to the materiel developer for approval, or the fiscal year approved if within the approval authority of the PIP proponent.

(c) The fourth and fifth digits are separated from the third by a hyphen (e.g., 1-80-03-1004). These digits stand for the general category of equipment being improved.

07 — Communications and electronics equipment.

(d) The sixth through ninth digits are separated from the fifth by a hyphen (e.g., 1-80-03-1004). These are assigned by the PIP proponent to identify each PIP. PIP proponents must ensure that no two PIP's have the same number.

B. THE FUNDING DISPLAY. All dollar entries are in millions carried to three decimal places (e.g., 17.213).

1. PRIOR YEARS

(a) In column a (PROG ISS'D), enter the net prior-year program releases to the agency executing the PIP.

(b) In column b (OBLIG), enter the total obligations against "program" shown in column a for all years before the FY of the reported period. Obligations are funds committed by the Government to a contract or issued by the materiel developer's comptroller for Government in-house work.

2. CURRENT FY. Enter the last two digits of the FY in which the reported quarter falls.

(a) In column c (FUNDED PROGRAM), enter the dollar amount funded by HQDA for the current FY program.

(b) In column d (UNFUNDED PROGRAM), enter the amount of the current FY program not funded by HQDA. The sum of columns c and d will equal the total current FY requirement.

3. BUDGET FY. Enter the last two digits of the current FY plus one.

(a) Enter in column e the dollar amount funded by HQDA for the budget year.

(b) Enter in column f the amount not funded by HQDA for the budget year. The sum of columns e and f will equal the total budget FY requirement.

4. PLANNED PROGRAM. In the heading of column g, enter the last two digits of the current FY plus two; enter each succeeding year in the headings of columns h through k. In the columns g through k, enter by appropriation the program requirements for each year; give a total for each year at the bottom of each column. Enter in column 1 (TO COMPL)

all funds needed after the FY shown in column k. In column m (TOTAL PROG), enter the total anticipated cost when the PIP is completed. (This column should be a total of columns a plus c through l.)

5. REC'D CUR FY. For each appropriation listed, enter the current FY funds received as of the end of the reporting period. (Show only the funds received, not those anticipated.)

6. CURRENT FY OBLICATIONS. This part of the form is used to display the obligations as planned and achieved. The PRIMIR submitted for the first quarter shows actual obligations made in the first quarter and obligations planned to be made in the following three quarters.

C. KIT PLAN. Show the past and projected number of kits procured (# PROC), delivered (# REC'D), and applied (# APPL'D). Enter also the man-hours (APPL M/H) needed to apply the kits. (Enter total man-hours for all the kits, not man-hours per kit.) If the PIP will not result in kits, enter NA in the "TOTAL" column on the "# PROC" line.

1. SOURCE OF INFLATION GUIDANCE. When preparing PRIMIR's, materiel developers will follow the latest inflation guidance published by the Comptroller of the Army.

D. ORIGINATOR DATA. Enter the PIP proponent on the first line and the materiel developer subordinate command preparing the PRIMIR on the second. Enter the name, office symbol, and AUTOVON phone number of the person preparing the PRIMIR or of a person who knows the details of the PIP and can be contacted to clarify it.

E. CECDC VALIDATION

1. VALIDATION STATUS. All PRIMIR's must have CECDC (or equal) validation.

2. Complete the ORIG PLAN, CUR PLAN, and ACCOMP columns as follows:

   (a) For all PIP's that have Phase II and III activity, a date must be entered in each block of the ORIG PLAN column. For PIP's planned only for Phase I effort, enter a date only in the PROJ INITIATED, TEST INITIATED, IND EVAL COM, and IPR/PROD DECISION blocks of the ORIG PLAN column.

   (b) Enter in the CUR PLAN column the quarter and FY of the latest estimate for completing each milestone.

   (c) Enter in the ACCOMP column the fiscal quarter and year when each milestone is actually completed.

3. A PIP is considered completed when all of the scheduled milestones shown in the ORIG PLAN column and all milestones later added in the CUR PLAN column are achieved.

F. MAJOR MILESTONES

1. Enter in this section the quarter and fiscal year when each milestone is expected to be completed or has been completed. The following is a description of each milestone:

(a) PROJ INITIATED. When work on the PIP begins.

(b) TEST INITIATED. When testing of the PIP begins.

(c) IND EVAL COM. When the PIP proponent receives the independent evaluator's assessment of the PI tests.

(d) IPR/PROD DECISION. When the IPR or production decision is made.

(e) PROD CON AWARD. When the contract for procuring hardware kits is signed.

(f) FIRST PROD HDW DEL. When the producer delivers the first kit for application.

(g) MOU NEGOTIATED. When the materiel developer and using MACOM's sign the last formal agreement that defines the MWO application program.

(h) FIRST KIT APP. When the first end item or component is modified.

(i) LAST KIT APP. When the last kit is applied to the equipment being improved.

(j) DATA COLL EVAL COMP. When the evaluation of the sample data collection is completed per the objectives and policies set forth in AR 750-37, in so far as practicable.

G. ILS IMPACT. Check yes or no.

H. RSI IMPACT. Check yes or no.

I. BRIEF TECHNICAL DESCRIPTION AND PURPOSE OF PIP. Describe the work to be done and why it must be done. Include in this description whether separate type classification as a distinct new item will be needed.

J. BENEFITS AND DRAWBACKS. Discuss benefits which may occur that are secondary to the main purpose.

K. METHOD OF IMPLEMENTATION. State whether the improved hardware will be applied by attrition or by mandatory MWO.

L. TEST PLAN. Outline the type of testing needed and summarize the extent of testing planned.

M. ACCOMPLISHMENTS DURING REPORTED PERIOD. Briefly describe any accomplishments or delays experienced.

N. REPROGRAMING DURING REPORT PERIOD. Show all reprograming during the report period.

O. REFERENCE REQUIREMENT DOCUMENT IF RDTE FUNDS SHOWN ON Page 1. If RDTE funds have been expended or will be needed for the PIP, cite the date and type of requirement document that describes the need for the improvement.

P. COMBAT DEVELOPER CONCURRENCE. Check the block that describes the type of concurrence that has been obtained or the block that states the PIP is still under coordination.

PRODUCT IMPROVEMENT MANAGEMENT INFORMATION R

For use of this form, see AR 70-15; the proponent agency is DEPUTY CHIEF OF STAFF FOR RESEARC

OMA MAJ GROUP	PA ACTIVITY	RDTE PROJECT NO. *(If RDTE $ shown below)*	
REPORT PER *(QTR/FY)*	JUSTIFICATION CODE	SSN/LIN OF SYS/END ITEM TO BE MOD - SSN	LIN
PIP IS ☐ NEW START ☐ SIG REV ☐ PREV APP ☐ LATE START	MAJOR COMPONENT	SSN	LIN

APPROP	PRIOR YEARS PROG ISS'D a	PRIOR YEARS OBLIG b	CURRENT FY ___ FUNDED PROGRAM c	CURRENT FY ___ UNFUNDED PROGRAM d	BUDGET FY ___ FUNDED PROGRAM e	BUDGET FY ___ UNFUNDED PROGRAM f	PLANNED PROGRAM FY ___ g	FY ___ h	FY ___ i	FY ___ j	FY ___ k
RDTE											
PROC MAJ ENG											
PROC MAJ HDW											
PROC SEC											
STOCK FUND											
OMA 2017 PUB											
OMA 2017 ENG											
OMA 2017 TNG											
OMA 2007 DEPOT											
OMA 2007 OTHER											
OMA 75 P010 SYS											
OMA 75 412 ENG											
OMA 75											
OMA 75											
TOTAL											

KIT PLAN	PRIOR YRS	CURRENT FY 1ST QTR	CURRENT FY 2D QTR	CURRENT FY 3D QTR	CURRENT FY 4TH QTR	BFY ___	FY ___	FY ___	FY	FY	FY
NO. PROC											
NO. REC'D											
NO. APPL'D											
APPL M/H											

PIP PROPONENT ____________________

COMMAND PREPARING PIP ____________________

POC ____________ OFC SYMBOL ____________

PHONE ____________ DATE ____________

*Total of columns a, c thru k.

CECDC VALIDATION:

☐ VALIDATED

☐ LEVEL I

☐ LEVEL II

☐ LEVEL III

DA FORM 3701-R, 1 May 80

EDITION OF 1 MAR 75 IS

INFORMATION REPORT ***(PRIMIR)***

STAFF FOR RESEARCH, DEVELOPMENT AND ACQUISITION.

	LIN	SYSTEM/END ITEM
	LIN	POP NAME OF PIP
		PIP NO.

PLANNED PROGRAM				RECD CUR FY	CURRENT FY OBLIGATIONS			
FY j	FY k	TO COMPL l	TOTAL PROG m*		1ST QTR	2D QTR	3D QTR	4TH QTR

FY	FY	TO COMPL	TOTAL	MAJOR MILESTONES	ORIG PLAN	CUR PLAN	ACCOMP
				PROJ INITIATED			
				[illegible]INITIATED			
				[illegible] EVAL COM			
				[illegible] DECISION			
				[illegible] BOARD			
				[illegible] DEL			
				[illegible]ATED			
				[illegible]PP			
				[illegible]PP			
				[illegible] EVAL			

CONTROL NO.

[illegible]TED

ION OF [illegible]TE.

, 3

ILS IMPACT ☐ YES ☐ NO	RSI IMPACT ☐ YES ☐ NO	SYSTEM/END ITEM

BRIEF TECHNICAL DESCRIPTION AND PURPOSE OF PIP:

BENEFITS AND DRAWBACKS:

METHOD OF APPLICATION:

TEST PLAN:

ACCOMPLISHMENTS DURING REPORTED PERIOD:

REPROGRAMMING DURING REPORTED PERIOD:

TO THIS PIP	FROM THIS PIP	APPROP	SOURCE OF FUNDS/REASON/IMPACT
$	$		

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SYSTEM/END ITEM	PIP NO.

REFERENCE REQUIREMENT DOCUMENT IF RDTE FUNDS SHOWN ON PAGE 1:

____

____

____

____

[ ] THAT DEVELOPER CONCURRENCE

[ ] WRITTEN CONCURRENCE OBTAINED
REFERENCE:

[ ] VERBAL CONCURRENCE OBTAINED

[ ] COORDINATION

POINT OF CONTACT

PHONE

PRODUCT IMPROVEMENT PROGRAM SUMMARY

For use of this form, see AR 70-15; the proponent agency is DEPUTY CHIEF OF STAFF FOR RESEARCH, DEVELOPMENT AND [illegible]

$ MILLION				PROGRAM FY									
SYSTEM AND PIP NUMBER	PRI	JUST CODE	PRIOR YR TOTAL	RDTE	PROCUREMENT ENG	[illegible]W	[illegible]C	SF	OMA 7M [illegible]17	[illegible]07		OMA 7[illegible] ENG	[illegible]

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EDITION OF 1 MAR 75 IS OBS[illegible]

DEVELOPMENT AND ACQUISITION.

PROCUREMENT APPROPRIATION

				FUTURE									
I		OMA 7S		RDTE	PROCUREMENT		SF	OMA 7M				OMA 7S	REVIEW RESULT
		ENG	APP		MAJ	SEC		P017	?207				

N OF 1 M[illegible] [illegible]ETE.

APPENDIX K

ENGINEERING RELEASE RECORD

The following instructions define and detail the completion of the Engineering Release Record (DARCOM Form 1742-R).

1. Block 1. Enter ERR number for release as established by the configuration manager or control activity, not to exceed 15 alphanumeric characters.

2. Block 2. When block 12 is signed, enter date of approval of the engineering release record in 6 numeric characters, year, month, day, (for example, 76 04 22).

3. Block 3. Enter sheet of sheets number, for example, 1 of 3.

4. Block 4. Check appropriate block to identify the baseline established or changed.

5. Block 5. Type of release, initial or change. Check appropriate block to indicate whether release is an initial release establishing a baseline, or a change to the baseline.

6. Block 6. Enter the ECP number and approval date, when applicable.

7. Block 7. Enter the functional assembly nomenclature.

8. Block 8. Enter the system or configuration item nomenclature.

9. Block 9. Optional use. This block can be used to note the item which the documentation identifies, that is, system specification, minor item, configuration item, engineering critical component, partial or complete releases, or any other remarks pertinent to the data being released.

10. Block 10. Data released or revised.

    a. CD ID. Enter code identification for the document to be listed conforming to Cataloging Handbook H4-1.

    b. Type. Enter the type of document, in accordance with MIL-STD-482, e.g., DL (Data List).

    c. Document Number. Self-explanatory.

    d. SHT NR. Self-explanatory.

    e. NR SHT. A total count of sheets constituting the document.

f. <u>Revision</u>. Revision symbol. Utilize a hyphen (-) to indicate original documentation.

g. <u>Date</u>. Enter the document date in six numeric characters, year, month, day (for example, 75 09 12).

h. <u>Releases. (IR) Initial Release</u>. Enter "X" if document is being initially released.

<u>Releases. (NAR) New Application Release</u>. Enter "X" if document has a new application.

i. <u>Changes. (CHG) Change</u>. Enter "X" for each document listed for which the revision level of an established baseline document is being changed.

<u>Changes. (CAN) Cancellation</u>. Enter "X" for each listed document which is to be deleted from an established baseline.

<u>Other</u>. For optional use.

11. <u>Block 11</u>. Self-explanatory.

12. <u>Block 12</u>. Self-explanatory.

ENGINEERING RELEASE RECORD

1 ERR NO	2 DATE	3 SHEET OF SHEETS

4 BASELINE ESTABLISHED OR CHANGED

☐ FUNCTIONAL ☐ ALLOCATED ☐ PRODUCT

5 TYPE OF RELEASE	6
☐ INITIAL ☐ CHANGE	ECP NO ______ DATE APPROVED ______

7 FUNCTIONAL ASSEMBLY NOMENCLATURE

8 SYSTEM/OR CONFIGURATION ITEM NOMENCLATURE

9 REMARKS/MISCELLANEOUS

10 DATA RELEASED OR REVISED

a CODE ID	DOCUMENT				REVISION		RELEASE		CHANGE		OTHER
	b TYPE	c NUMBER	d SH OF	SHEETS	f LTR	g DATE	FR	CLASS	CR	CAN	

11 SUBMITTED BY	DATE	12 APPROVED BY

DARCOM Form 1724-R
26 Feb 1970

ENGINEERING RELEASE RECORD
CONTINUATION SHEET

ERR NO	DATE	SHEET OF SHEETS

a CODE ID	DOCUMENT				REVISION		RELEASE		CHANGE		OTHER
	b TYPE	c NUMBER	d SH	OF SHEETS	f LTR	g DATE	CR	WAR	CN	CAN	

DARCOM Form 1724a-R
26 Feb 1970

DAT
ILM